The Institution of Gas Engineers

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OX 31

37th REPORT OF THE GAS EDUCATION COMMITTEE: 1959-60

COMMUNICATION No. 576

The Gas Education Committee has pleasure in submitting to the Council of The Institution of Gas Engineers its Report for the period 1st August, 1959, to 31st July, 1960.

A. E. HAFFNER,
Chairman, Gas Education Committee.

W. T. K. BRAUNHOLTZ,
Secretary, The Institution of Gas Engineers.

17, GROSVENOR CRESCENT,
LONDON, S.W.1.

31*st July*, 1960.

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I GENERAL

Membership of Gas Education Committee

Chairman: A. E. Haffner, Ph.D., B.Sc.

Institution Nominees: F. L. Atkin; D. Beavis; A. F. Grant, B.Sc.(Eng.); S. K. Hawthorn; R. F. Hayman, B.Sc.; H. Johnston, O.B.E.; G. H. Kenyon, M.Sc.(Tech.); R. N. Le Fevre, M.B.E.; E. T. Pickering, B.Sc.; L. F. Randall; J. C. C. Ransom, B.Sc.; W. K. Tate, M.A.

Board of Examiners' Nominees: A. C. Jennings; B. Wilkinson, B.Sc.

Gas Council Nominees: A. B. Badger, M.A., Ph.D.; R. D. Moyle, M.A., LL.B.

Society of British Gas Industries' Nominees: A. Rees Jones, Ph.D.; L. J. L. Walker.

British Junior Gas Associations' Joint Council Nominee: W. F. Pritchard.

Ministry of Education Nominees: N. S. Capper, H.M.I.; F. Caunce, H.M.I.; J. Maitland-Edwards, H.M.I.

Scottish Education Department Nominee: L. Pendleton, H.M.I.S.

Ministry of Education for Northern Ireland Nominee: J. M. Benn, M.A.

Department of Education for Eire Nominee: C. Mullally.

City and Guilds of London Institute Nominee: A. D. Graham, B.A.

District Gas Education Committee Nominees: R. J. Gavin (Eastern); H. H. Thomas, B.Sc. (Lancashire); C. P. Astbury; M.Eng. (Midland); F. J. Webster (Northern); R. J. Faulkner (Scottish); A. H. Savill, M.Sc. (London and Southern); A. Marsden, M.B.E., M.Sc., Ph.D. (South Western); A. Pickard (Wales and Monmouthshire); P. H. Beahan, B.A. (Yorkshire).

Ex officio: President, Vice-Presidents and Honorary Secretary.

The resignation of Mr. G. H. Potter (Sheffield), as Honorary Secretary of the Midland District Gas Education Committee and as its representative on the Gas Education Committee, was received with regret. The Institution records its gratitude to Mr. Potter for his services. He has been succeeded by Mr. C. P. Astbury, M.Eng. (Birmingham).

Mr. L. F. Randall (Leicester), Chairman of the Sales Training Committee, has been appointed to the Committee as a representative of the Council of the Institution for the period 1959 to 1962.

Mr. G. Dougill, M.Sc. (Chigwell), who represented The Institution of Gas Engineers on the Engineering Institutions' Examination Standing Committee for Part I, has, on his retirement from the Gas Industry, resigned from the Committee and has been succeeded by Mr. R. Whiting (Ipswich). The Committee desires to express its appreciation to Mr. Dougill of his services in this connexion.

Advisory Committee on Education and Training to The Gas Council

The Institution has continued throughout the year to collaborate with The Gas Council in regard to technical education, and liaison between the Advisory Committee on Education and Training to The Gas Council and the Gas Education Committee of the Institution has been maintained by the representatives of the Institution upon the former and by those of The Gas Council upon the latter.

Administration

The practice of referring applications from students for exemption from the Institution's examinations, or parts thereof, to a Sub-Committee has been continued throughout the year.

Lectures for Young People

Accounts are given below of lectures to young people, which have been given, during the year, in London and in provincial cities and towns, under the aegis of The Institution of Gas Engineers and of its District Sections and affiliated Associations. These lectures now constitute a well established feature of the educational programme of the Institution.

An essential feature of the lectures and one that is particularly appreciated by the educational authorities is that direct advertisement of the Gas Industry is avoided. Nevertheless, through the medium of the lectures, thousands of young people have been introduced in an interesting, informative and often entertaining manner to the manifold applications of town gas for domestic, commercial and industrial purposes. The prestige value of the lectures, although indirect, must be very considerable and there can be little doubt that they justify the effort, time and expense they involve.

The Institution desires to acknowledge its indebtedness to the lecturers and its appreciation of the ready assistance and co-operation of the Sections and Associations, the Area Gas Boards, the Universities and Technical Colleges and all who contribute towards the success of these lectures.

London

The ninth London Lecture for Young People was given, by kind permission of the Rector, in the Imperial College of Science and Technology, South Kensington, S.W.7, on the afternoon of 5th January, 1960. The lecturer was Mr. J. E. Davis, O.B.E., Chief Technical Officer of the South Eastern Gas Board, who repeated the lecture, entitled "The Movement of Gases", that he gave on 1st January, 1954, an account of which was given in the 31st Report of the Gas Education Committee (*Communication* 454).

There was an audience of approximately 220 drawn from schools in London and the Home Counties.

In the unavoidable absence of the President, the lecturer was introduced by the Senior Vice-President, Mr. H. S. Cheetham, who, after the lecture, also expressed the appreciation of the audience to Mr. Davis and his team of demonstrators.

The number of demands for repeat demonstrations during the interval and at the close of the lecture provided evidence of the enthusiastic manner with which the young people received the lecture.

Glasgow

A lecture, entitled "Harnessing the Flame", was given by Mr. J. A. Prigg, B.Sc. (Watson House, London), in the McLellan Galleries, Glasgow, on Friday, 29th January, 1960. Mr. W. S. Johnston, President of the Scottish Association of Gas Managers, under whose auspices the lecture was held, welcomed the 400 to 500 girls and boys from the various schools in Glasgow. The President of The Institution of Gas Engineers, Mr. D. D. Melvin, was also present at the lecture.

Liverpool

A Christmas Lecture on "Combustion" was given, on 30th December, 1959, by Dr. R. Williamson, M.Sc.(Tech.), Chief Chemist, North Western Gas Board, in the Muspratt Lecture Theatre of the University of Liverpool. The lecture was arranged by the Manchester and District Section of the Institution, together with the Lancashire District Gas Education Committee, and the audience of 290 sixth

form pupils was welcomed by Mr. J. Castle, B.Sc., honorary secretary of the Section.

Dr. Williamson discussed the nature of combustion, from first principles in relation to gases, liquids and solids, to modern applications of combustion principles, with particular reference to the use of town gas and industrial gases generally. A large number of experiments, some spectacular, were carried out and were well received by the audience.

Manchester

Dr. R. Williamson repeated the lecture, on "Combustion", that he gave in Liverpool, in the Dalton Lecture Theatre of the University of Manchester, on Thursday, 7th January, 1960. The audience of about 330 girls and boys was welcomed by Mr. A. H. Nicholson, Chairman of the Manchester and District Section.

Nottingham and Wolverhampton

A Christmas Lecture, entitled "Flame", was given, by Mr. J. E. Cooper, B.Sc., Technical Officer (Utilization), East Midlands Gas Board, to a delighted audience of senior schoolchildren, at Wolverhampton, on 13th January, 1960, when approximately 500 children attended, and twice at Nottingham on 21st January, 1960, when about 400 attended in the morning and a similar number in the afternoon.

At Wolverhampton, the lecturer was introduced by Mr. J. S. Fox-Andrews, Chairman of the Midland Section. Also present were Mr. W. R. Branson, M.Sc., Deputy Chairman of the West Midlands Gas Board, and Mr. G. W. R. Lines, B.A., M.Ed., Director of Education, Wolverhampton. The lecture was featured in the B.B.C.'s Midland News on both television and sound radio.

Mr. J. S. Fox-Andrews introduced the lecturer at Nottingham, also, and Mr. W. G. Jackson, B.A., M.Ed., Director of Education, Nottingham, was present.

With the assistance of an interesting display of apparatus, Mr. Cooper demonstrated the nature of the gas flame and its propagation along tubes. At the end of the lecture, the children crowded around the tables for a closer inspection. The success of the lecture was clearly evident on all three occasions.

The lecture was very well reported in the Nottingham press. One report said: "The only gas-fired organ in the World came to Nottingham today, and the children sat enthralled as wavery notes emerged to the tune of "Three Blind Mice".

Reading

A Christmas Lecture on "Flame", arranged under the auspices of the London and Southern Section, was given, by Mr. W. F. Thorne, B.Sc. (Chief Chemist to the Southern Gas Board, at Reading Technical College on 1st, 4th, 5th and 6th January, 1960, before seven audiences totalling over 600. Opportunity was taken to invite to a rehearsal 78 of the Board's gas fitting apprentices.

The various sessions were presided over by Mr. R. F. Robinson, Chairman of the London and Southern Section; Mr. A. F. Hetherington, Deputy Chairman of the Southern Gas Board, and Mr. A. E. Smith and Mr. J. Jones, Members of the Southern Gas Board.

The B.B.C. made a fairly comprehensive sound and vision recording for "Children's Newsreel".

The lecture commenced with an historical review of the flame and combustion, followed by about 30 experiments designed to illustrate in an interesting manner some important fundamental properties and behaviour of flames.

Leeds

The Murdoch Lecture for 1960 dealt with "Flame in the Service of Man" and was delivered by Dr. J. E. Garside in a lecture-room at the Houldsworth School of Applied Science in the University of Leeds, on 27th April, to an audience of about 120 boys and girls from a cross-section of West Riding secondary and grammar schools.

In introducing the lecturer, Mr. J. M. McLusky spoke of the interest of The Institution of Gas Engineers in sponsoring such lectures for young people, and referred briefly to the importance of obtaining knowledge on the behaviour of flame to harness it for the benefit of mankind.

Dr. Garside's lecture was followed with keen interest, and his audience was greatly interested in the development of his theme and, in particular, in the many practical illustrations.

At the close of the lecture, Mr. J. G. Tilley (Huddersfield), a member of the Institution Council, proposed a vote of thanks to the Senate of the University and to Professor A. L. Roberts, Hon.M.Inst.Gas E., who made it possible to use the lecture-room, to Dr. Garside for giving the lecture, and to Radiation, Limited, for the loan of certain of the equipment used in the demonstrations.

Short Refresher Course for Engineers

The Council of The Institution of Gas Engineers, acting upon a suggestion put forward by Mr. W. K. Hutchison, C.B.E., while he was an Honorary Councillor of the Institution, arranged a Short Course for Engineers, at Pembroke College, Oxford, from 3rd to 9th April, 1960.

The course was designed for station engineers and deputy station engineers, but engineers occupying appropriate positions on the Headquarters staffs of Area Gas Boards and engineers from member firms of the Society of British Gas Industries were also invited. There were 50 members of the course, 45 of whom were nominated by Area Gas Boards and five by the contracting Companies. It was conducted under the directorship of Dr. A. E. Haffner, B.Sc., Chairman of the Institution's Gas Education Committee, and the Assistant Secretary of the Institution, Mr. A. G. Higgins, M.Sc., acted as Administrative Secretary.

Pembroke College, Oxford, was selected because, by reason of its size and the facilities that it had to offer, it was considered to be ideal for the purpose and all the activities of the course, with the exception of works visits, could be carried out within its precincts.

The course was not intended as a means of providing a platform for the presentation and discussion of highly specialized papers, but as a means of offering to engineers, who are normally fully occupied with their day-to-day activities, an opportunity of exchanging views and experience with their colleagues in different parts of the country and of being brought up-to-date with current trends and developments.

The course comprised two main features, consisting of a programme of lectures followed by consideration and discussion of the lectures by meetings of syndicates. There were five syndicates of 10, which met separately to consider the papers and themes suggested for consideration by the lecturers. The syndicates subsequently met and reported their findings. It was possible, by selecting a different spokesman for each reporting session, to enable most of the members of the course to have an opportunity of presenting a syndicate's case.

This procedure proved to be successful, and at the final session, when the syndicates reviewed the week's work, it became apparent that, although more time would have been

welcomed for it, the syndicate discussion was regarded as one of the most valuable aspects of the course.

The following programme of lectures was arranged:—

"Raw Materials and Basic Processes", by J. E. Davis, O.B.E., F.R.I.C., M.Inst.Gas E., Chief Technical Officer, South Eastern Gas Board

"Purification", by G. U. Hopton, B.A., B.Sc., M.Inst.Gas E., M.I.Chem.E., Senior Research Chemist, North Thames Gas Board.

"Structures", by E. O. Rose, B.Sc., M.I.C.E., M.Inst.Gas E., Chief Engineer, Eastern Gas Board.

"Handling of Materials", by S. K. Hawthorn, M.I.C.E., M.Inst. Gas E., Divisional Engineer, West Midlands Gas Board.

"Safety", by H. G. Hall, A.M.I.Mech.E., Safety Officer, North Western Gas Board.

"Statistical Aids to the Engineer", by B. G. H. Clegg, M.A., F.I.S., Assoc.Inst.Gas E., Market and Operational Research Manager, Southern Gas Board.

"Steam and Power in the Gas Industry", by L. J. Clark, B.E.M., M.Sc.(Eng.), M.I.Mech.E., M.Inst.Gas E., M.Inst. F., A.M.I.C.E., A.M.I.E.E., Assistant Chief Engineer (Development and Planning), North Thames Gas Board.

"A Manufacturer's View of Maintenance", by D. Marks, B.Sc.(Eng.). A.M.I.Mech.E., Instalment and Service Manager, W. H. Allen, Sons and Company, Limited.

"Chemical Control", by W. F. Thorne, B.Sc., M.Inst.Gas E., A.R.I.C., Chief Chemist, Southern Gas Board.

"Inoffensiveness", by A. E. Haffner, Ph.D., B.Sc., A.R.C.S., F.I.F., M.Inst.Gas. E., M.I.Chem. E., Chief Engineer, Southern Gas Board.

"Instrumentation", by T. A. Lucas, B.Sc., Assoc.M.Inst.Gas. E., Instrument Engineer, South Eastern Gas Board.

On the first afternoon of the course, the Bursar of the College, Mr. G. Bredin, C.B.E., M.A., took the members of the course on a conducted tour of the College, relating its history and indicating features of architectural interest. This was very much appreciated and added to the interest of residing and working in such attractive surroundings.

Visits were arranged for two afternoons, to the works of Morris Motors, Limited, at Cowley, and to the Esso Research Centre at Abingdon.

The course was officially opened on Monday, 4th April, by Mr. W. K. Hutchison, C.B.E., and on the final evening the President of the Institution gave a dinner party in the College Hall, at which the principal guests, were Sir Dennis Proctor, K.C.B., M.A., Permanent Secretary, Ministry of Power; Mr. R. B. McCallum, M.A., Master of the College; Sir Henry Jones, M.B.E., M.A., Chairman, The Gas Council; Mr. W. K. Hutchison, C.B.E., Deputy Chairman, The Gas Council; Mr. C. H. Leach, M.A., Chairman, Southern Gas Board; Mr. G. Bredin, C.B.E., M.A., Bursar of the College. Sir Dennis Proctor and the President were able to stay until the following morning to hear the concluding review of the course by the syndicates and by the Director.

The Institution greatly appreciates the support and assistance it has received from the Ministry of Power, The Gas Council, Area Gas Boards, the Society of British Gas Industries and the College in this new venture. It acknowledges also its indebtedness to the lecturers and to the two companies that entertained the members of the course at their works.

It is proposed to conduct a similar course in April, 1961, for distribution engineers and their deputies responsible for divisions or equivalent parts of Areas, for members of headquarters distribution staff of similar rank, and for member firms of the Society of British Gas Industries.

Short Course for Teachers of Gas Fitting

The course was conducted at the Southampton Technical College, from 17th to 23rd July, 1960, and residential facilities were arranged at Connaught Hall, a hall of residence of the University of Southampton. The applications were greatly in excess of accommodation available and attendance was limited to 42 teachers, selection being determined largely on geographical considerations, so that all areas of Great Britain were represented. Many of those attending were full-time or part-time teachers of gas fitting employed by Area Gas Boards, but there were also several full-time teachers from technical colleges. The course was directed by Mr. F. Caunce, H.M.I., assisted by Mr. A. W. Doyle, H.M.I.; Mr. S. G. Lawrence, H.M.I., and Dr. D. Ridge, H.M.I.

The usual curriculum adopted for these courses was amended in order that particular emphasis could be placed on teaching techniques and on the teaching of craft science. The revised scheme for the examinations of the City and Guilds of London Institute in gas fitting, which are to become operative as from the examination to be conducted in May, 1962, dispenses with so-called ancillary subjects. Such calculations and science as are necessary for a proper appreciation of the subject are included in the syllabuses for the written examinations in gas fitting. This change has been deemed necessary since the former ancillary subjects mathematics, engineering science and engineering drawing were inappropriate to the needs. It is hoped that the integration of the subject matter into one comprehensive syllabus will prove to be more appropriate, but it is recognized that it will inevitably place additional responsibilities upon the teachers of gas fitting.

Southampton Technical College was selected as the centre for this course, since it has developed the teaching of craft science to a fine degree, and the Head of its Building Department, Mr. A. W. Nobbs, is an acknowledged authority on the subject.

The course was opened by Dr. A. E. Haffner, B.Sc., Chairman of the Gas Education Committee of the Institution, who as Vice-President of the Institution and as a Member of the Southern Gas Board was deputizing for both the President of the Institution (Mr. H. S. Cheetham), and the Chairman of the Board (Mr. C. H. Leach, M.A.), in their unavoidable absence. This was followed by a discussion on the new curriculum for the examinations of the City and Guilds of London Institute in gas fitting, which was introduced by Mr. A. D. Graham, B.A., and Mr. J. J. McVey, B.Sc.(Econ.), officials of the Institute. The remainder of the first day and the following two days were devoted to gas fitting science and comprised lectures by Mr. Nobbs on "The Purpose of Gas Fitting Science" and "Organization of Experimental Work" and demonstrations by Mr. Nobbs and his colleague, Mr. K. C. Ball, of various experiments that could be simply made and used to illustrate the scientific principles required for an appreciation of the revised syllabus.

Details of 112 experiments in gas fitting science were supplied to the members of the course, and most of them were set up in two laboratories where they could be inspected and used by them. The time available enabled every member of the course to carry out several of the experiments under ideal conditions.

Mr. W. F. Thorne, B.Sc., Chief Chemist to the Southern Gas Board, gave a lecture entitled "The Nature of Flame", which was essentially the lecture he has so successfully given to hundreds of young people during the previous two Christmas vacations, adapted to suit the present audience.

Another innovation, which occupied a substantial part

of the second half of the course, was the provision of an opportunity for every member of the course to give a lecture or demonstration. The course was divided into three syndicates, each having a syndicate leader (Mr. H. Skilton, Mr. G. E. Taylor and Mr. M. Glasspool) so that each member of the course had an audience of 14 for his lecture or demonstration. The subjects of the lectures or demonstrations were drawn by ballot at the beginning of the course, and laboratories, workshops or classrooms were available according to the requirements of the lecturers.

This innovation provided a challenge to the members of the course, to which they responded in a very satisfactory manner, but it occupied a substantial portion of the time available. Many members felt that they would have obtained greater assistance from the course if more formal lectures on teaching techniques and on teaching craft science could have been substituted for this practical work.

Two stimulating lectures on "Effective Teaching" and "Aids to Effective Teaching" by Mr. L. S. Powell, and a most valuable and informative talk by Mr. G. B. Parsons on "Sketching and Calculations" completed the programme.

Those fortunate enough to attend the course must have been greatly encouraged and stimulated in their work as teachers of gas fitting, and it is hoped that they will find opportunities of passing on some of the knowledge and experience they have gained to their colleagues.

The Institution expresses its gratitude to the officials of the Ministry of Education; the Principal, Head of the Building Department and Staff of the Southampton Technical College; the Warden of Connaught Hall, and the Chairman, Members and officers of the Southern Gas Board, for their co-operation in the administration of this course.

It is proposed next year to arrange a course for teachers of Gas Technology (Manufacture), (Distribution) and (Utilization).

Sandwich Courses

Sandwich Courses by means of which many young student apprentices are trained in gas engineering, have continued to be operated at the Royal Technical College, Salford; the College of Technology, Birmingham; Enfield Technical College, and Westminster Technical College. In Scotland, a course similar to a Sandwich Course is conducted at the Heriot-Watt College, Edinburgh. Successful candidates are awarded the Associateship of the college, which is accepted as an examination qualification for Associate Membership of the Institution. No candidate has yet completed the course, but it was pleasing to learn from the college that the gas engineering students are comparing favourably in their studies with students in other faculties.

Reference was made in the 36th Report of the Gas Education Committee (*Communication* 553) to the possibility of upgrading one or more of the Sandwich Courses from three-year to four-year courses with the Ordinary National Certificate or its equivalent in the General Certificate of Education as the initial commencing qualification, and to the possibility of making appropriate provision for a course leading to the award of the Diploma in Technology. This matter is now being actively considered by a sub-committee of the Industrial Relations Committee of The Gas Council, whose findings are awaited with interest.

Success in the Sandwich Courses, except at Enfield Technical College, where the students still enter for the Institution's examination, is accepted by the Institution as satisfying the current examination requirements for Associate Membership, and, in order to assure that the standards required by the Institution are attained, assessors have been appointed by all Colleges.

The Sub-Committee appointed by the Gas Education Committee to consider the preparation of a model scheme of practical training to be associated with Sandwich Courses in gas engineering, has prepared a recommended programme, which has received the approval of the Committee and of the Council and has been circulated to Area Gas Boards. It is included in this Report as Appendix 1.

Consideration has been given by the Committee to the procedure to be adopted in the case of students who unfortunately fail in one or more subjects in the final year of a Sandwich Course in gas engineering and are thereby precluded from obtaining the College Associateship or Diploma, which is an examination qualification accepted for election to Associate Membership of The Institution of Gas Engineers.

Whether or not the candidates will be allowed to re-sit examinations for the purpose of obtaining the college Associateship is a matter entirely within the prerogative of the college, but the colleges have been requested to give sympathetic consideration to allowing such students to re-sit the examination and so successfully complete a Sandwich Course notwithstanding the fact that it might not be possible to award the Associateship or Diploma of the college. In these circumstances, exemption from the Associate Membership Examination would be granted.

It has been recommended by the Gas Education Committee and approved by the Council that candidates will be allowed to have one further attempt at not more than two subjects in the final year of a Sandwich Course. If still unsuccessful, they will be required to take Part II, Group D, of the Associate Membership Examination of the Institution, in order to qualify for election to Associate Membership.

The Council has approved a recommendation of the Gas Education Committee of the Institution that a copy of the I.G.E. Safety Recommendations be presented to the libraries of the technical colleges conducting Sandwich Courses in gas engineering. These copies will be kept up-to-date with amendments and additions, free of charge to the colleges.

Woodall-Duckham Educational Fund

In 1958, grants were made from the Woodall-Duckham Educational Fund to enable two young qualified engineers each to attend two of the Summer School Courses at the Institute of Gas Technology, Chicago. Mr. A. R. Bovington, B.Sc. (London) and Mr. W. E. Dobson (Birmingham) were selected from a long list of applicants for these courses, and, on their return, they between them lectured to all the Junior Gas Associations on their experience and on the knowledge they had gained. The excellence of the lectures as well as of their reports, which are available in the library of the Institution, prompted the Council to repeat the experiment, and, at the time of preparing this Report, two more engineers, Mr. G. B. Scott (Glasgow) and Mr. A. Yates (Cardiff) are attending Summer School Courses in Chicago.

City and Guilds of London Institute

The Institution has long valued the close collaboration it enjoys with the City and Guilds of London Institute. The Institute is represented on the Gas Education Committee by Mr. A. D. Graham, B.A. (Assistant Technical Director), and the Institution has representatives on the two Advisory Committees of the Institute dealing with gas subjects.

The Gas Education Committee was accordingly delighted to receive an invitation from the Director of the Institute for the Committee to hold one of its meetings in its new premises, 76, Portland Place, London, W.1, and to take the opportunity of inspecting them. This opportunity and the courteous reception afforded to the Committee by the Deputy Director (in the unavoidable absence of the Director) were very much appreciated.

Reference has been made earlier in this Report to the completely new approach that is being made in connexion with the teaching of gas fitting and of amendments to the examinations that will arise therefrom. The current trend in functional development of the Gas Industry, by reason of which a revision of the regulations for the Associate Membership Examination is to be introduced in 1962 (*vide Communication* 553, p. 10) has also been considered by the Advisory Committee of the City and Guilds of London Institute, and a similar revision of the regulations for the examinations in Gas Technology (Manufacture) and (Supply) is now in course of preparation. It is proposed to offer separate examinations in Gas Technology (Manufacture), Gas Technology (Distribution) and Gas Technology (Utilization), and as in the case of gas fitting to dispense with separate ancillary subject examinations and to incorporate into comprehensive syllabuses all of the technology and associated subjects required. As in the case of the other revisions to which reference has been made, examinations on these revised syllabuses will not be available before 1962.

Training in Engineering

W. H. Allen, Sons and Company, Limited, Bedford, are making arrangements to conduct a further course, of four weeks' duration, for engineers, which is to be attended by six gas engineers in company with a number of engineers from other industries. The curriculum will follow closely that of previous courses, to which references have been made in earlier Reports of the Gas Education Committee.

The Institution was pleased to be invited to collaborate with the Area Gas Boards in selecting engineers to attend this course.

Register of Teachers

After the annual re-registration on 1st April, 1960, of teachers on the Institution's Register of Teachers, the number now stands at 258. It is apparent from observations made by the teachers attending the Short Courses for Teachers arranged by the Ministry of Education that the Register continues to be of great value to them.

As a result of a suggestion made at the Short Course held at Pulborough in 1959, enquiries were made as to the number of teachers who regularly receive the *Technical Bulletins* issued by the Watson House Centre. Most of the teachers in fact receive copies through the Area Gas Boards, but there are a number of full-time teachers employed by local education authorities for whom no provision was hitherto made. The Gas Council has kindly agreed to supply sufficient copies to the Institution to enable it to distribute them to those teachers on the Register who do not already receive them.

Earlier in this Report, reference is made to a list of experiments in gas fitting science, which teachers might find of value in dealing with the new syllabuses in the gas fitting examinations of the City and Guilds of London Institute. This list was distributed to those teachers who attended the Short Course held in Southampton in July, 1960, and the Institution is very grateful to Mr. A. W. Nobbs, of the Southampton Technical College, for permission to circulate it to all of the teachers on the Register.

London and Home Counties Regional Advisory Council for Technological Education

The Institution was represented by the Assistant Secretary, Mr. A. G. Higgins, M.Sc., at the Annual Conference of the London and Home Counties Regional Advisory Council for Technological Education, held in Switzerland from 27th June to 2nd July, 1960. A report on this conference is available in the library of the Institution.

District Gas Education Committees

The District Gas Education Committees have continued throughout the year their work of liaison with the Area Gas Boards and the Colleges. The co-optation of the Education Officers of the Boards and of representatives of the technical colleges on the District Committees is proving of considerable assistance in this connexion.

Certificate in Gas Salesmanship and Consumer Service

As a result of the revision of the examination of the City and Guilds of London Institute in Gas Technology (Supply), it has been necessary to make a corresponding amendment in the regulations for the Certificate in Gas Salesmanship and Consumer Service. Full details are given in the Report of the Sales Training Committee. (See p. 92 of this *Communication*.)

The number of candidates entering for the written examination in May, 1960, was lower by 13 than in May, 1959, but it is pleasing to note that the general higher standard achieved last year has been maintained. The Report of the Examiners is included in the Report of the Sales Training Committee. (See p. 93 of this *Communication*.)

The next written examination in the Principles and Practice of Gas Salesmanship is provisionally arranged to be held on 2nd May, 1961. The closing date of entry for external candidates is 1st January, 1961, and for internal candidates entered through technical or commercial colleges is 28th February, 1961.

The oral examinations are normally held in October and November, and the closing date for entry is 1st October.

Associate Membership Examination

(1) *Revision of the Associate Membership Examination*

The proposals for the revision of the Associate Membership Examination, which are to be operative as from the examination to be conducted in October, 1962, were fully reported in the 36th Report of the Gas Education Committee (*Communication* 553, p. 10.). Since that Report was published, a further proposal was received, from The Institution of Civil Engineers, to the effect that the subject engineering materials be omitted from the curriculum. This proposal was welcomed by the Gas Education Committee, since this subject has for some time been regarded as inappropriate by many members of the Committee. It is not proposed to replace it by any other, since when the revised regulations become operative there will be two additional papers dealing with the specialist aspects of gas engineering.

(2) *Common Preliminary Examination*

The results obtained by candidates entered through The Institution of Gas Engineers for the Common Preliminary Examination of the Engineering Joint Examination Board were disappointing.

Three candidates entered for the October, 1959, examination. One took two subjects, in both of which he passed, the second took one paper, which he failed, and the third failed in all three papers for which he entered.

In April, 1960, there was only one candidate, who took only one paper, in which he failed.

Relatively few candidates are required to take the Common Preliminary Examination, since most of them obtain exemption through possession of a General Certificate of Education in appropriate subjects, or of National Certificates.

(3) *Part I, Section A*

In October, 1959, five candidates entered for the whole examination, only one of whom was successful. A sixth, candidate, who had only the principles of electricity to take, was unsuccessful.

In April, 1960, there was a pleasing increase in the number of candidates, but the results were, unhappily, far from satisfactory. Of 19 candidates who sat for the whole of Part 1, with the exception of English, from which subject all were exempt, six passed, two were referred in one subject and 11 failed. In addition, there were four candidates who were required to take only one subject. Two of these were successful and two failed.

(4) *Part I, Section B*

In October, 1959, there were four candidates, only one of whom passed, and in April, 1960, there were two candidates, one of whom was successful.

(5) *Part II, Group D*

The accompanying table summarizes the entries and results for the October, 1959, and April, 1960, examinations.

Papers taken	October, 1959		April, 1960	
	Number of Candidates	Results	Number of Candidates	Results
1	2	3	4	5
1. Whole of Part II, Group D	—	—	11	8 passed 3 failed
2. Gas Engineering (Manufacture) (2 papers)	—	—	2	1 passed 1 failed
3. Gas Engineering (Manufacture) 2nd paper only	15	13 passed 2 failed	10	9 passed 1 failed
4. Gas Engineering (Manufacture) (2 papers) and Applied Chemistry	1	1 passed	—	—
5. Gas Engineering (Supply) (2 papers)	3	3 passed	3	3 passed
6. Gas Engineering (Supply) 2nd paper only	9	9 passed	4	4 passed
7. Applied Chemistry only	2	2 passed	1	1 passed
Total	30		31	

The Report of the Board of Examiners on the main subject examinations is given on p. 88.

(6) *Reports from the Colleges Conducting Sandwich Courses in Gas Engineering*

(*a*) *Royal Technical College, Salford*

During the session, the total number of students attending the gas engineering courses was:—

1st year .. 23
2nd year .. 24
3rd year .. 23

The following analysis shows the number of students attending the course from the five Gas Boards supporting the Sandwich Course:—

	First Year	Second Year	Third Year
North Western	10	17	13
North Eastern	4	3	5
Northern	4	Nil	1
Wales	3	1	Nil
South Western	1	Nil	3
Others	1	3	1
Total	23	24	23

In the final year of the course, the disposition of the 23 candidates in the three fields of gas engineering was:—

Production 10
Distribution 6
Utilization 7

The college Associateship was awarded to 22 students, whose names are given in Appendix 2 of this Report.

(*b*) *College of Technology, Birmingham*

During the 1959-60 session, 14 students enrolled in the first year of this course, 13 in the second, and 12 in the third, a total of 39. Of the 12 candidates presenting themselves for the final examination, 10 were successful, five in Manufacture and five in Supply. The names of the successful candidates are listed in Appendix 2. During the session, arrangements were made with the Gas Council's Midlands Research Station, Solihull, for a member of its staff to work for the award of Membership of The College of Technologists. The work, which will be in the field of gas-fired furnace design and control, will be done under the joint supervision of the staff of the Department and the Research Station and will be located in each centre as appropriate. The college welcomes this opportunity of participating in the research activities of the industry.

(*c*) *Westminster Technical College*

During the 1959-60 session, the first intake of students completed their course. At the same time, there were 15 students in the second year of the course. As the intake is in alternate years, there were no students in the first year.

For the specialist subject in the final year, considerable help

was given to the college by the Gas Boards which allowed many of their senior staff to act as visiting lecturers, so that the students were given up-to-date knowledge of the industry.

During the year, the London County Council approved a special grant for the purchase of further equipment. All this is now on order, and much of it has been delivered.

The above mentioned students attended a course in Gas Engineering (Manufacture). It was hoped that it would be possible to conduct a course in Gas Engineering (Supply), but, unfortunately, there were insufficient students.

(7) *Post Higher National Certificate Course at the College of Technology, Birmingham*

The course was run for the third and final year during the past session, with 10 students from the Eastern, East Midlands, and West Midlands Gas Boards. All the students were successful in the final examinations.

The course has undoubtedly served a useful purpose and has, over the past three years, trained 35 students who would otherwise have had considerable difficulty in obtaining tuition for the Institution's examinations. It is perhaps unique that no student whatsoever failed the course over the three years. This is probably due to the fact that candidates had already proved their academic abilities by passing the Higher National Certificate examinations in mechanical engineering prior to joining the course.

(8) *Charles Hunt Memorial Medals*

The Charles Hunt Memorial Medal in Gas Engineering (Manufacture) was awarded to M. J. Tidd (London).

The Charles Hunt Memorial Medal in Gas Engineering (Supply) was awarded to K. Frost (West Kirby).

(9) *Examinations, 1961*

Associate Membership Examination of The Institution of Gas Engineers:

Examination		Date
April, 1961 (Part I)	..	17th to 19th April.
(Part II)	..	11th to 13th April.
October, 1961 (Part I)	..	9th to 11th October.
(Part II)	..	3rd to 5th October.

Diplomas in Gas Engineering

There were no candidates for Diplomas in Gas Engineering in 1959-60.

Applications for admission to the Diploma Examinations must be made not later than 30th November, on forms obtainable from the Secretary of the Institution, and must be accompanied by (i) a brief synopsis of the subject selected by the candidate for his thesis, for approval of the Board of Examiners; and (ii) the examination fee of five guineas, which will be returned if the candidate is not admitted.

Since the proposed revised regulations become operative in 1962 and in accordance with them the Diploma Examination is discontinued, the examination for the Diploma to be held in 1961 will be the last.

Acknowledgments

The Gas Education Committee desires to express its thanks to all those who render assistance in connexion with the administration of the education scheme, and particularly to the Government Education Departments, The Institution of Civil Engineers, the Board of Examiners, the District Gas Education Committees, The Gas Council and the Area Gas Boards, the Sales Training Committee and its Examiners, the City and Guilds of London Institute, the Principals of Technical Colleges and Teachers throughout the country conducting approved courses in Gas Engineering, Gas Technology and Gas Fitting, the Examining Bodies conducting ancillary-subject examinations for external students at home and overseas, and to the Education Officers and Department of H.M. Forces.

II REPORT OF THE BOARD OF EXAMINERS: 1960

The Board of Examiners has pleasure in submitting to the Gas Education Committee, for presentation to the Council of The Institution of Gas Engineers, its report on the 1960 examinations held under the Education Regulations of the Institution (*Communication* 432).

During the year 1959-60, the members of the Board of Examiners, appointed by the Council, were:—

Gas Engineering (*Manufacture*)—

B. Wilkinson, B.Sc. (Ipswich); F. Grocott, B.Sc. (Birmingham); E. Johnson, Ph.D., B.Sc. (Leicester); J. B. McKean, B.Sc. (London); G. H. Potter (Sheffield); M. Redman, B.Sc.(Tech.) (Manchester).

Gas Engineering (*Supply*)—

A. C. Jennings (Birmingam); W. E. Medhurst (Croydon); J. A. Prigg, B.Sc. (London); M. F. Scott (Cardiff); K. Summersgill, B.Sc. (Manchester); W. H. Tarn (Cardiff).

EXAMINATIONS: 1960

This report relates only to the examinations held in October, 1959, and April, 1960, in Gas Engineering (Manufacture) and (Supply), which were conducted by the Institution's Board of Examiners and which are regarded by The Institution of Gas Engineers as the main subjects.

In other subjects in Part II, Group D, of the Associate Membership Examination, the Examiners are appointed by The Institution of Civil Engineers, although in the case of applied chemistry (gas), the appointments are made on the nomination of The Institution of Gas Engineers. The results obtained by the Institution's candidates in this subject as well as those in the Part I Examinations are reported in the 37th Report of the Gas Education Committee.

The table given below shows the number of candidates entering for the examinations in the sessions 1958-59 and 1959-60, together with the average marks awarded.

	October, 1958		April, 1959		October, 1959		April, 1960	
	1st Paper	2nd Paper	1st Paper	2nd Paper	1st Paper	2nd Paper	1st Paper	2nd Paper
1	2	3	4	5	6	7	8	9
Gas Engineering (Manufacture)								
Number of entries	5	22	8	21	1	16	11	21
Average Marks ..	52·6	41·6	47·9	47·3	37·0	48·7	42·8	45·1
Gas Engineering (Supply)								
Number of entries	5	10	10	15	3	12	4	9
Average Marks ..	48·0	44·4	57·7	55·4	51·3	52·7	54·5	48·2

There was a decrease in the number of candidates compared with the previous session, the total number being 58 as opposed to 68.

More candidates entered for the second paper only, those taking this paper only being candidates who had successfully completed a Higher National Certificate or a Post Higher National Certificate course in Civil and Gas Engineering, thereby obtaining exemption from the first paper. There were, however, some candidates from Sandwich Courses, who, in addition to taking the college examinations, entered externally for the purpose of qualifying for membership of The Institution of Civil Engineers.

It was apparent to the Examiners that in all of the examinations to which this report relates the candidates did not realize the care taken in wording the questions. Had they done so, they might perhaps have attempted to provide the answer sought instead of hastening to put down anything they remembered vaguely related to the subject. This must be a complaint made by Examiners since examinations first started, but often the Examiners feel it regrettable that a candidate should waste his opportunities for lack of the appreciation that only answers to the questions score marks and no exhibition of other knowledge substantially assists his case.

OCTOBER, 1959, EXAMINATIONS

GAS ENGINEERING (MANUFACTURE)

Only one candidate sat for the first paper and there is therefore no object in commenting on the answers except to say that he scored a low mark and his efforts in the second paper confirmed his standard.

In the second paper, it is gratifying to record that the impression gained was of a slight improvement in standard compared with recent examinations; the presentation was better, but careless arithmetical errors were still evident. While there was no outstanding candidate, the top mark being 58 per cent, more than half the candidates obtained 50 per cent or over.

Table Showing Number of Candidates Answering Each Question and Average Marks Obtained:

(25 *Marks for Each Question*)

Question No.	First Paper		Second Paper	
	Number of Answers	Average Marks	Number of Answers	Average Marks
1	2	3	4	5
1	1	11	12	12·0
2	1	8	14	12·1
3	1	8	15	12·3
4	—	—	14	12·3
5	1	10	6	15·0
6	—	—	3	5·6
Total ..	4	9·2	64	12·1

GAS ENGINEERING (SUPPLY)

1st Paper

The distribution questions were badly answered and no candidate attempted to answer the practical question about the servicing of domestic gas appliances. The two industrial questions were reasonably popular and well answered.

There were too few candidates to justify the publication of observations on answers to individual questions.

2nd Paper

The general standard appears to be reasonable, and the average mark for the examination was 52·75 per cent. No candidate was worse than 38 per cent, nor was any better than 68 per cent. The answers in general were inclined to be verbose, and the standard of sketching was low, the sketches being badly drawn, too small and insufficiently annotated.

Table Showing Number of Candidates Answering Each Question and Average Marks Obtained:

(25 *Marks for Each Question*)

Question No.	First Paper		Second Paper	
	Number of Answers	Average Marks	Number of Answers	Average Marks
1	2	3	4	5
1	3	4·0	10	15·5
2	1	15·0	9	13·3
3	3	14·3	5	15·8
4	0	—	12	13·3
5	2	16·0	2	14·5
6	3	17·3	10	9·1
Total ..	12	12·8	48	13·2

APRIL, 1960, EXAMINATIONS

GAS ENGINEERING (MANUFACTURE)

Questions involving calculations are usually either avoided or poorly answered. In the first paper, eight of the 11 candidates attempted the calculation, and not one completely correct answer was submitted; but in the second paper, 19 of the 21 candidates attempted the calculation and with some measure of success.

It is gratifying to find that candidates were prepared to tackle these calculations.

Candidates, of course, acquire their knowledge partly from lectures and the literature and partly from their works experience. The questions that called upon their academic studies were reasonably well answered, but it was apparent in the answers to questions dealing with routine testing and gas works experience that candidates were not making the most of their works experience for lack of a critical approach.

Descriptions of chemical tests were frequently not of the standard methods, and the reasons for performing the tests were not fully appreciated by many candidates. There was also a lack of understanding of the more fundamental production practice and methods of assessing the performance of conventional plant.

The Examiners have been trying for some time to include a question that will reveal whether the candidates have any idea of costs, and such a question was included in this examination. Of the 21 candidates taking the second paper, 13 attempted this question, but it was evident that, although they had some reasonable idea of the cost into holder, there was little knowledge of the magnitude of the components. One wonders how many candidates have the opportunity to see manufacturing costs.

The standard of presentation showed little or no improvement. There was the usual tendency to the use of slang and of terms that were lacking in precision.

Second Paper

The general standard obtaining in the examination left much to be desired, though two quite fair papers were presented. In numerous instances, the marks obtained for the different questions varied widely with the candidate, indicating the absence of a good all-round knowledge of gas engineering. Ten of the successful candidates were border-line cases.

There was a general tendency to cloak ignorance by such phrases as " one must keep the plant running at maximum

efficiency", when the candidate obviously did not know what to do to attain such a condition.

There were distinct indications that candidates had obtained their knowledge from textbooks or from tutors not abreast of modern developments and nomenclature within the industry.

Gas engineering is not a fundamental technology, since it comprises aspects of chemistry, together with chemical, mechanical, civil and electrical engineering. The gas engineer must have a good grounding in these basic technologies, but requires a considerable amount of practical knowledge and experience that are peculiar to gas alone. The acquisition of this practical knowledge and experience must, therefore, depend on the enquiring mind of the candidate in his daily work. There was evidence in the papers to indicate that the thirst for knowledge was either not there or had been easily quenched.

Table Showing Number of Candidates Answering Each Question and Average Marks Obtained:

(25 *Marks for Each Question*)

Question No.	First Paper		Second Paper	
	Number of Answers	Average Marks	Number of Answers	Average Marks
1	2	3	4	5
1	8	11·4	19	14·1
2	7	10·1	17	10·1
3	8	12·0	7	9·3
4	6	8·1	16	8·2
5	7	10·4	10	16·3
6	8	11·1	13	9·9
Total ..	44	10·3	82	11·4

GAS ENGINEERING (SUPPLY)

First Paper

Of the four candidates who submitted answers, three were above average and showed a fairly good grasp of the subject of gas supply generally.

In this paper, as in the first paper in the October, 1959, examination, there was a question on gas compressing plant. On both occasions, and also on previous occasions, questions of this type were poorly answered, indicating a lack of knowledge of the subject.

On jet burners, one candidate wrote a very good answer on conventional tunnel burners, but had failed to appreciate that the Examiners required information on recent technical developments.

In view of the small entry, no comments on answers to individual questions are offered.

Second Paper

Nine candidates submitted answers that varied considerably in quality.

In general, the answers in many cases were not sufficiently concise and contained a good deal of matter not asked for in the question.

Table Showing Number of Candidates Answering Each Question and Average Marks Obtained:

(25 *Marks for Each Question*)

Question No.	First Paper		Second Paper	
	Number of Answers	Average Marks	Number of Answers	Average Marks
1	2	3	4	5
1	3	9·3	2	6·5
2	1	17·0	7	12·0
3	4	15·7	8	11·9
4	2	14·0	6	12·1
5	3	14·0	6	14·3
6	3	13·3	6	13·3
Total ..	16	13·6	35	12·4

CHARLES HUNT MEMORIAL MEDALS

The Charles Hunt Memorial Medal in Gas Engineering (Manufacture) was awarded to Mr. M. J. Tidd (London).

The Charles Hunt Memorial Medal in Gas Engineering (Supply) was awarded to Mr. K. Frost (West Kirby).

B. WILKINSON,
Chairman, Board of Examiners.

W. T. K. BRAUNHOLTZ,
Secretary, The Institution of Gas Engineers.

17, Grosvenor Crescent,
London, S.W.1.

12*th September*, 1960.

III REPORT OF THE CITY AND GUILDS OF LONDON INSTITUTE ON TECHNOLOGICAL EXAMINATIONS: 1960*

The following general report is given on the papers as a whole and is not necessarily applicable to the work from individual schools.

There were two papers and the candidates were asked to answer five questions on each paper. All the candidates attempted the full number of questions.

With so few papers, an analysis of the results cannot be of much value. It is interesting to note, however, that in general the candidates attempted the same questions.

12.—GAS TECHNOLOGY (SUPPLY)

Year		No. of Cands.	1st Class	2nd Class	Failed	Percentage of: 1st Class	2nd Class	Failed
1	2	3	4	5	6	7	8	9
1960	Candidates taking complete Paper	41	9	18	14	21·9	44·0	34·1
	Candidates taking 1st Paper only	233	171		62	73·3		26·7
	Candidates taking 2nd Paper only	62	40		22	64·5		35·5
1959	Candidates taking complete Paper	31	9	11	11	29	35·5	35·5
	Candidates taking 1st Paper only	209	122		87	58		42
	Candidates taking 2nd Paper only	77	50		27	65		35
1958	Candidates taking complete Paper	54	18	8	28	33·3	14·8	51·9
	Candidates taking 1st Paper only	153	87		66	56·9		43·1
	Candidates taking 2nd Paper only	21	15		6	71·4		28·6

It is gratifying to note that this year the diminishing trend of candidates taking the complete paper has been halted and there is a slight increase, whilst the number of candidates taking the first paper only have also increased fairly considerably.

The Examiner is most gratified to report a general improvement in the quality of answers received. This shows up particularly with regard to the candidates taking the first paper only.

A fairly large section of candidates are still, however, well below standard with regard to their sketching, some of the sketches offered being such as would be a disgrace to a primary school.

12.—GAS TECHNOLOGY (MANUFACTURE)

Year	Number of Candidates	First Class	Second Class	Failed	Percentage Passed
1	2	3	4	5	6
1960	4	1	2	1	75·0
1959	18	4	10	4	77·7
1958	7	3	4	—	100·0
1957	11	2	6	3	72·8
1956	23	2	14	7	69·5
1955	34	2	26	6	82·0
1954	15	1	12	2	86·6

Of the four candidates who submitted papers for marking, one was of first-class pass standard, two were of second class, and one candidate failed.

13.—GAS FITTING

Intermediate

Year	Number of Candidates	Passed	Failed	Percentage Passed
1	2	3	4	5
1955	1,437	468	969	32·6
1956	1,360	643	717	47
1957	1,311	611	700	48·8
1958	1,264	427	837	33·7
1959	1,302	635	667	48·7
1960	1,262	713	549	56·5

Final

Year	Number of Candidates	Passed	Failed	Percentage Passed
1	2	3	4	5
1955	1,111	462	649	41·6
1956	993	465	528	47
1957	1,049	424	625	40·3
1958	1,036	519	517	50
1959	965	493	472	51·1
1960	985	565	420	57·4

Intermediate Grade (Written Paper).—The results were encouragingly higher, with a better standard all round. Weaknesses were: (1) using the wrong formula in the calculations, (2) inaccurate meter reading, (3) faulty completion of the diagram of the circulation system.

Intermediate Grade (Practical Test).—The results were slightly lower. Though there is some improvement as far as steel is concerned, there still appears to be a general lack of ability to work accurately with copper pipe and to set steel pipe cold.

Final (Written Paper).—There was a slight improve-

* The Examiners' remarks on individual questions have not been included in these reports, but copies may be obtained from the Secretary of The Institution of Gas Engineers, upon request.

ment on last year's results. Failure to read the questions correctly, and a tendency to complicate simple problems, continues to be the main causes of forfeiture of marks.

Knowledge of industrial control equipment was good, but many candidates omitted to indicate a non-return valve on the air-line. Too many candidates still cannot arrange meter by-passes with neat, short layouts.

Water heating diagrams were good, but several mistook the instantaneous water heater for a circulator.

In the calculations question, nearly half the candidates erroneously used the formula πr^2 to obtain the surface area of the run of pipe.

Answers to some of the more practical questions were disappointing. For example, relatively few candidates gave "plug tap" as the correct tool for cutting a female screw-thread in a blind hole in metal. "Tap" alone was not good enough for a Final Grade answer, whilst "taper tap" was quite unacceptable.

Final (Practical Test).—The general standard was good, the average being about the same as last year. The only noteworthy weakness continues to be lack of accuracy when bending copper pipe.

IV SALES TRAINING AND CONSUMER SERVICE

REPORT OF THE SALES TRAINING COMMITTEE AND OF ITS PANEL OF EXAMINERS: 1959-60

The membership of the Sales Training Committee is as follows:—

Chairman: L. F. Randall.

Gas Education Committee Nominees: W. T. Lane, G. H. W. Madge; W. K. Tate, M.A. *Ex officio:* A. E. Haffner, B.Sc., Ph.D., Chairman, Gas Education Committee.

Gas Council Nominees: A. B. Badger, M.A., Ph.D.; R. N. LeFevre, M.B.E.; A. McDonald, B.Sc.; F. E. F. Salter.

Ministry of Education Nominee: F. Caunce, H.M.I.

Incorporated Sales Managers' Association Nominee: C. C. Knights, F.S.M.A.

Society of British Gas Industries Nominees: C. T. Baker-Carr; S. L. Pleasance.

The current Regulations for the Certificate in Gas Salesmanship and Consumer Service require success in, or exemption from, certain written examinations including Part I of the examination in Gas Technology (Supply) of the City and Guilds of London Institute, together with appropriate ancillary subjects.

The City and Guilds of London Institute now has the regulations for its examinations in Gas Technology under review and, *inter alia*, separate examinations in Gas Technology (Distribution) and Gas Technology (Utilization) are to be conducted as from May, 1962.

The syllabuses for the examinations in Gas Technology (Utilization) have been approved and published. There are two examinations—an Intermediate and a Final. The Intermediate comprises two papers in domestic gas utilization, and the Final two papers in commercial and industrial gas utilization. The Advisory Committee of the City and Guilds of London Institute, in preparing the syllabuses for these examinations, integrated the necessary ancillary subjects into the syllabus for the main subject, since it had been found that in many Centres the ancillary subjects provided for the candidates in Gas Technology (Manufacture) and (Supply) had not been really appropriate to their needs.

This revision was welcomed by the Sales Training Committee, which has been aware for some time that recruitment of students for the examination had been hindered by inclusion of ancillary subjects which many thought were inappropriate and unnecessary.

The Sales Training Committee has recommended to the Council, which has accepted and approved the recommendation, that, for the purpose of the Certificate in Gas Salesmanship and Consumer Service, the Intermediate Examination (comprising two three-hour papers) in Gas Technology (Utilization) be used in place of Gas Technology (Supply—Part I) and the associated ancillary subjects engineering drawing S1, engineering science S1 and mathematics S1.

The Committee has also considered the question of English S1, which has also in the past been regarded by many as unsatisfactory, since exemption from the examination could be obtained as a result of success in quite unsuitable courses. The Committee has accordingly under consideration the preparation of a syllabus in commercial or business English, the main purpose of which will be to train students in the art of communicating their thoughts and ideas, either verbally or in writing, and to help them to develop the faculties of clear thinking and exact expression.

New regulations will accordingly shortly be published which will be operative as from 1962, and will require success in written examinations in the aforementioned subjects, together with the Principles and Practice of Gas Salesmanship and also in an oral examination.

The Committee has also given consideration to a proposal that a higher qualification in sales and service, such as a Diploma, be established. This matter has been referred to The Gas Council, whose views thereon are awaited with interest.

In the written examination in the principles and practice of gas salesmanship, held on 3rd May, 1960, there was a decrease in the number of candidates compared with the previous two years, there being 13 candidates less than in 1959 and 10 less than in 1958. The generally improved standard noted by the Examiners last year was maintained, although the percentage of first-class passes was a little lower.

Again, there was a reasonable geographical distribution of candidates, indicating that the Certificate is now finding more general acceptance than was the case for a good many years after its initiation.

Oral Examinations—November, 1959

The oral examinations were conducted by six pairs of Examiners, in five different Centres, on lines that were, as far as was practicable, identical. A meeting of the Examiners was held, prior to the examinations, to discuss the form the examination should take, and a standard marking schedule was devised which was used by all Examiners.

The examination of a candidate was conducted in a room that was set up so as to provide, firstly, facilities for preliminary discussion, and, secondly, a limited display of selected domestic appliances to represent a good showroom. The services of a home service adviser were in most cases enlisted to act as a customer to whom the candidate was

required to demonstrate his abilities as a salesman and to whom he could indicate the merits of the various appliances.

Generally, the Examiners were well pleased with the candidates coming forward for examination. By far the greater proportion of them had actually had selling experience, and it had been refreshing to find that a more lively appreciation of current trends in the industry and of its future development had been exhibited. There was a much higher standard of confidence, particularly in connexion with the future of space heating.

There were obviously some points of criticism, a selection of which are listed below, but it is desirable to point out that these are specifically mentioned in order to be of assistance to future candidates and not to detract from the fact that the overall results were satisfactory. Of 74 candidates, only eight were failed, and as a result of the oral examination 10 were upgraded from the second-class achieved in the written examinations to first-class passes.

Points of criticism noted by Examiners included:—

(i) A great reluctance on the part of many candidates to "close the sale". This may perhaps have been due to the fact that candidates, under examination conditions, endeavoured to ensure that they exhibited as much knowledge as possible before terminating the interview. It is an understandable fault, but one that should be avoided.

(ii) Some candidates concentrated on reciting a specification of a gas cooker rather than upon the benefits to be gained from modern gas cookers equipped with modern devices.

(iii) Insufficient knowledge was displayed of comparative running costs of gas and electrical appliances.

(iv) There was a degree of slackness in the dress of some candidates.

(v) Many candidates paid insufficient attention to endeavouring correctly to assess the customers' needs or the buying motives that had directed them to the showroom.

The results of the oral examinations are summarized in the following table:—

Results of the Oral Examinations, 1959

	1st Class Written. 1st Class Oral.	1st Class Written. 2nd Class Oral.	2nd Class Written. 1st Class Oral.	2nd Class Written. 2nd Class Oral.	2nd Class Written. Failed Oral.
1	2	3	4	5	6
Centre A	1	1	–	9	1
Centre B	–	–	5	6	1
Centre C	–	1	2	10	–
Centre D	–	–	1	11	1
Centre E	3	–	2	14	5
Total	4	2	10	50	8

Summary

Class of Award	Number of Candidates on the Results of the Written Examination	Number of Candidates on the Results of the Oral Examination
1	2	3
1st Class	6	14
2nd Class	68	52
Failed	—	8
Total	74	74

Written Examination—May, 1960

Part A of the paper was set and marked by Mr. D. W. Smallbone (Incorporated Sales Managers' Association), and Part B by Mr. H. A. Edkins. Mr. W. T. Lane acted as assessor for the examination as a whole.

REPORT OF THE EXAMINERS APPOINTED BY THE SALES TRAINING COMMITTEE*

The Examiners for 1960 have pleasure in submitting to the Sales Training Committee, for presentation to the Council of The Institution of Gas Engineers, their report on the 1960 examination in the Principles and Practice of Gas Salesmanship.

The examination comprised two parts, for each of which five questions were set, candidates being invited to attempt three.

The results are summarized in the following table:—

Class	Internal—66		External—47		Total—113	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
1	2	3	4	5	6	7
1st	1	1·5	3	6·4	4	3·5
2nd	42	63·6	33	70·2	75	66·4
Failed	23	34·9	11	23·4	34	30·1

Compared with 1959:—

Class	Internal—96		External—30		Total—126	
	No.	Per cent.	No.	Per cent.	No.	Per cent.
1	2	3	4	5	6	7
1st	13	13·5	1	3·3	14	11·1
2nd	58	60·5	23	76·7	81	64·3
Failed	25	26·0	6	20·0	31	24·6

Examiners' Remarks

The total number of candidates this year was 113, a reduction on the last two years, but it is gratifying to note that the general higher standard that was achieved last year has been maintained.

One disappointing factor, however, must be the considerably reduced number of first-class passes, four as against 14 for 1959.

Against this, however, is the fact that for the first time, so far as the present Examiners are concerned, the number of candidates who were successful in Part A of the paper has increased over the number successful in Part B (75 to 72, as compared with 75 to 87 for 1959 and 50 to 67 for 1958). This would appear to indicate that candidates are acquiring greater knowledge and/or wider experience of the art of general salesmanship.

The standard of the papers judged from the markings showed a very considerable improvement.

* The Examiners' remarks on individual questions have not been included in these reports but copies may be obtained from the Secretary of The Institution of Gas Engineers, upon request.

Summary and Analysis of Part A

		Per cent.	Average Marks
1	2	3	4
Passed	75	66	43·0
Failed	38	34	27·5

Some candidates did not read the questions, and gave answers unrelated to them. Some answers straight from the book were just not tenable within the described circumstances.

It is interesting that attention was evenly divided between the questions.

Summary and Analysis of Part B

		Per cent.	Average Marks
1	2	3	4
Passed	72	64	43·0
Failed	41	36	29·0

The answers in the main showed that the students had a better and more general knowledge of current trends in the manufacture and availability of new and different appliances and that they were conversant with the changing pattern of gas usage.

Great importance is attached to drawing students' attention to the new markets for gas, both in the domestic and commercial fields, during their training.

The papers submitted this year carried too many cliches, which in themselves are completely meaningless.

Stupid phrases such as "a must", "all rounder", probably carry no weight whatsoever in convincing any customer that the appliance or fuel under consideration fills completely his own particular need. If this sort of phrase is written in an examination paper, then it must be assumed it is used in the conduct of business.

Table Showing the Number of Answers Submitted to Each Question and the Average Marks Awarded

(25 Marks for Each Question)

Question No.	Number of Answers	Average Marks
1	2	3
1	78	13·3
2	61	12·9
3	61	10·8
4	85	12·8
5	53	13·0
6	48	12·5
7	37	11·0
8	99	13·4
9	66	12·7
10	87	13·2
Total number of questions answered = 675 Maximum number of questions required = 678 Average marks per question = 12·7		

H. A. EDKINS,
W. T. LANE,
D. W. SMALLBONE,
Examiners.

W. T. K. BRAUNHOLTZ,
Secretary, The Institution of Gas Engineers.

17, Grosvenor Crescent,
London, S.W.1.
12th September, 1960.

APPENDIX 1

SANDWICH COURSES IN GAS ENGINEERING: RECOMMENDED PROGRAMME FOR PRACTICAL TRAINING

(1) INTRODUCTION

A Sandwich Course consists of periods of theoretical training at a college of technology or a technical college, undertaken alternately with periods of practical training. The Institution recommends that those attending such an organized course of practical and theoretical education and training should be described as undergoing student engineering apprenticeship. They may be referred to as either "student engineers" or "student apprentices". The Institution regards the former as preferable. This Appendix relates only to a programme of practical training which is recommended by The Institution of Gas Engineers as appropriate to the needs of student gas engineers, undergoing training by the Sandwich Course system.

It is emphasized that student engineers should work to a syllabus during their practical training as carefully planned and supervised as is their course at the college.

Wherever possible, it is advantageous for student engineers before commencing an organized programme of practical training to be given an induction period during which they are made acquainted with the various activities of the undertaking. The numbers recruited at any one time, and other local conditions, will determine whether such induction training is better given by means of formal courses or on a personal basis.

The method of introducing a student engineer so recently from school into practical training and the industrial atmosphere is particularly important, and the best means will depend on local circumstances. Where possible, the introduction, as one of the group under a tutor, by an initiation course based either on the drawing office or a works laboratory or workshops has many advantages.

(2) PURPOSES OF PRACTICAL TRAINING

The principal purposes of practical training may be submarized as follows:—

(i) To give the student engineer a broad appreciation of the practical aspects of gas engineering in the three fields of production, distribution and utilization of town gas.

(ii) To provide opportunties for student engineers to acquire knowledge and experience of the practical application of the theoretical principles studied at the college.

(iii) To enable student engineers to acquire confidence in their dealing with plant, materials and people and to develop the personal characteristics which will be of importance to them in their future careers as gas engineers.

(iv) To supply the means of assessing the particular field of gas engineering for which the student engineer shows greatest potentiality.

(v) To acquire some knowledge of the management and administrative structure of the undertaking.

(3) Outline of the Model Programme

In a five-year student engineering apprenticeship, there are, allowing for holidays, approximately 150 weeks available for practical training. If, therefore, the most effective use is to be made of this limited time, it is essential that each section of the training programme be thoroughly organized.

Because students enter the gas industry at different ages, with qualifications at different levels, and commence the theoretical course at the college at different points in their careers, and because college courses start at different times of the year, the programmes of practical training which follow are divided into six periods, each of 25 weeks' duration, to provide the flexibility needed to meet these conditions.

Local differences in organization and availability of plant will necessarily influence the way in which each of the 25-week periods will be allocated and organized, but the importance of arranging detailed programmes for each period cannot be over-emphasized.

The programmes provide for basic training in the application of engineering and chemical principles, general training in the three principal branches of gas engineering—production, distribution and utilization—and specialized training in one of these branches.

Whilst the programmes are intended to provide a flexible pattern of practical training, there are certain fundamental principles to be followed, if the training is to be fully effective.

(i) As far as practicable, the practical training should be kept in phase with the theoretical training at the college.

(ii) It is highly desirable that the content of the first and second periods be followed, although the order in which the subjects are taken might well be varied according to the facilities available. Local conditions will to a large extent determine whether a newly recruited student engineer will commence his practical training in the drawing office, laboratory or engineering workshops.

(iii) As far as is compatible with the training programme, the student engineer should be given work to do which is useful to the undertaking and which he can recognize as such. This consideration, however, should in no circumstances be interpreted as implying that student engineers may be available for holiday relief or as means of mitigating temporary shortages of staff. Compliance with the training programme should always be regarded as of primary importance. To this end, it is expected that the student engineer will be given manual work to do wherever applicable as part of his training. Further, at some stage during his practical training, preferably towards the latter stages, the student engineer should have experience of shift work.

(iv) Responsibility for the day-to-day practical training of the student engineer should rest with line management and he should receive his instruction from the officers of the various departments of the undertaking to which he is assigned during his training periods. It is considered, however, that appropriate officers of the undertaking, preferably qualified engineers, should be nominated to take responsibility for a student engineer, to act as his mentors and to follow his progress and to advise him throughout his studentship.

(v) It is essential that student engineers maintain full accounts of their practical training. This end is most conveniently achieved by the keeping of a daily diary and a technical record or journal. Apart from the value of these records *per se* to the student engineers, they will also provide both the employers and the technical college staffs with a measure of the student engineers' progress and may be of value to assessors who might take them into consideration when dealing with borderline cases in the examinations in the final year of the college courses.

Some notes on the maintenance of students' records are given as follows:—

Student's Diary and Journal

(1) Two journals should be maintained by each student engineer, one in the form of a daily diary which should be of a convenient size (6 in. × 4 in.) for carrying around in which entries should be brief and relate to day-to-day experience.

The second should be a log book or journal of foolscap size and should comprise the technical record of the student engineer's practical training. It should be properly indexed and entries therein dated.

(2) Entries in the log book should provide a balanced account of the subject being studied. Theoretical aspects that have been the subject of study at the college should be treated briefly. In this connexion, reference should be made to appropriate entries in the college note book. Notes should be directed especially to local considerations, e.g., reasons for installing the particular plant under study, any modification from normal design, details of plant operation and performance, safety precautions, personnel engaged and their duties.

(3) The log book or journal should be regarded as a technical record and should contain basic information abstracted from technical literature to which the student engineer wishes to have ready access, together with, and in appropriate relation to, the basic information of plant and works practice of which he is given experience during his training.

(4) The entries in the log book or journal should be accompanied by sketches of plant wherever possible to show a student's understanding of a process or mechanism and to give him the valuable facility of sketching quickly and clearly, and in accurate proportion. To this end, all sketches should be made entirely freehand and should be practised while out on the plant. These sketches should subsequently be affixed in the journal.

(5) For ease of inspection or reference by either the student or other persons, free use should be made of headings and sub-headings. The entry should not be cramped, e.g., generally when commencing to write upon a new subject a fresh page should be used.

(6) A list of contents should be entered inside the cover.

RECOMMENDED PROGRAMME OF PRACTICAL TRAINING

Period (Weeks)	Manufacture	Distribution	Utilization
25	12 weeks. **Drawing Office :** To cover S1 and S2 engineering drawing. 10 weeks. **Laboratory :** To cover sampling of solids, liquids and gases, proximate analysis of coal and analysis of products of carbonization, Works tests and the control of Works processes. 3 weeks. **Engineering Workshops :** To cover basic fitting and the use of hand tools.	12 weeks. **Drawing Office :** To cover S1 and S2 engineering drawing. 10 weeks. **Engineering Workshops :** To cover basic fitting, the use of hand tools, working with fitters, welders, platers and machinists. 3 weeks. **Mains and Services Department.**	12 weeks. **Drawing Office :** To cover S1 and S2 engineering drawing. 13 weeks. **Gas Fitting :** To cover a practical gas fitting course and district experience.
25	7 weeks. **Engineering Workshops :** Working with fitters, blacksmiths, platers, welders and machinists. *9 weeks. **Distribution Department :** To include mains and service laying, operation and maintenance of gasholders, boosters and governors and a short period with a distributing engineer or senior technical assistant. *9 weeks. **Utilization :** To cover gas fitting, the work of the appliance and meter workshops and of industrial gas workshops, and a period with a sales and service superintendent.	7 weeks. **Mains and Services Department.** *9 weeks. **Manufacture :** Including 4 weeks in the Works laboratory, 2 weeks on a gas-making plant, 2 weeks on wet and dry purification plant, and 1 week on steam, power and mechanical plant. *9 weeks. **Utilization :** (As for the manufacture student engineers.)	7 weeks. **Gas Fitting :** Assisting a foreman fitter. *9 weeks. **Manufacture :** (As for the distribution student engineers.) *9 weeks. **Distribution :** (As for the manufacture student engineers.)
25	**Gas-making Plant :** Carbonizing plant, carburetted water gas plant, oil gas plant.	13 weeks. **Gasholders, Boosters and Governors.** 12 weeks. **Contract Work :** With inspectors on supervision of work being carried out by contractors.	4 weeks. **Stores :** Stores control and supplies to the district. 9 weeks. **District :** With a technical service superintendent. 12 weeks. **Appliance and Meter Workshops.**
25	11 weeks. **Gas Treatment and Purification.** 12 weeks. **Steam, Power and Mechanical Handling.** 2 weeks. **Central Laboratory :** To cover instrumentation, testing of coke, refractories, paints, lubricating oils, etc.	8 weeks. **Distribution Control.** 13 weeks. **Distribution Drawing Office.** 4 weeks. **Central Laboratory :** To cover instrumentation, soil testing, protection, etc.	12 weeks. **Industrial Gas Sales :** With industrial gas representative or in the industrial gas workshops. 13 weeks. **Utilization Drawing Office and Laboratories.**
25	24 weeks. **Headquarters Planning Department, Central Construction Department, or equivalent :** Drawing office and inspection, control and progress, site work. 1 week. With headquarters production control.	24 weeks. **Headquarters Planning Department, Central Construction Department, or equivalent :** Drawing office and inspection, control and progress, site work. 1 week. With headquarters production control.	10 weeks. **District Office :** 5 weeks. **Showroom.** 10 weeks. **District Sales and Service :** Working with a district representative.
25	Under the direct supervision of a station engineer working as a personal assistant and being given an opportunity of seeing something of all aspects of operation and organization.	Under the direct supervision of a divisional or group distributing engineer, working as a personal assistant and being given an opportunity of seeing something of all aspects of operation and organization.	Under the direct supervision of a district, group or divisional manager, working as a personal assistant and being given an opportunity of seeing something of all aspects of operation and organization.

* These periods are included to meet the requirements of the proposed revision of the Institution's Associate Membership Examination.

APPENDIX 2

NAMES OF CANDIDATES TO WHOM CERTIFICATES HAVE BEEN AWARDED

ASSOCIATE MEMBERSHIP EXAMINATION CERTIFICATES

Gas Engineering (Manufacture)

Arnold, John Frank	Hinckley
Ball, Harold James	Wellington
Birkett, Iain Malcolm	Stocksfield
Bingham, Brian Henry	London
Bolton, Grahame John	Watford
Carter, Edwin Albert John	Herne Bay
Chandler, Derek Hugh Warwick	Orpington
Clough, John Hacking	Preston
Craiggs, David	Hexham
Green, Raymond Thomas	Waltham Cross
Hines, John Martyn	Harrogate
Hodnette, David Geoffrey	Wolverhampton
Hukin, Raymon	Sheffield
Ireland, John Michael	London
Lewis, Ernest Lyndon	Deepfields
Ling, George Edward	Lincoln
Miller, Robert Underwood	Coatbridge
Mills, Donald	London
O'Keeffe, Michael John	Methil
Seed, Sandford	Liversedge
Stephens, Keith Stanley Archer	Southend-on-Sea
Tidd, Michael Joseph	London
Tooley, Malcolm Reginald	Loughborough
Watson, David	Morley
Weller, Brian Robert	Maidstone
White, John Derek	London
Williamson, David Michael	Methil
Wyle, Joseph Geoffrey	Old Hill

Gas Engineering (Supply)

Batten, Ronald Alfred	London
Chapman, Alan Percy	Enfield
East, Alec Percy Ralph	Crays
Emmerson, Roy Cecil	Ottord
Frost, Kenneth	Ossett
Hadaon, George Arthur	Stockton-on-Tees
Hathaway, Artnur George	Kingston-on-Thames
Hedges, William Sydney Garth	London
Holmes, Allan	Derby
Lodge, Harry	Normanton
Milne, Reginald	Liverpool
Poole, Colin Gilbert	Leicester
Richards, Stanley Robert	London
Rodgers, Michael James Arthur	London
Stokes, Keith Harry	Newcastle
Stone, Malcolm Henry	Oxford
Sutton, Jack Victor	London
Way, David Douglas	Bristol
Webb, Michael Slinn	Sheffield
Weir, Thomas	Bedlington
Wilson, Thomas Henry	Earls Barton

CERTIFICATE IN GAS SALESMANSHIP AND CONSUMER SERVICE

The examinations in the Principles and Practice of Gas Salesmanship relating to these Certificates were held in previous years, but the oral examinations were concluded in the session 1959-60.

Class	*Name*	*Town*	*Area Board*
First	Butler, Francis Harry	Birmingham	West Midlands
,,	Cook, Robert Henry	Maidstone	South Eastern
,,	Crosby, David Michael	London	South Eastern
,,	Foster, Peter Herbert	bath	South Western
,,	Hobbs, Kenneth Philip John	Swindon	South Western
,,	Jenkins, brian Wallace	Taunton	South Western
,,	Long, Thomas Henry	Luton	Eastern
,,	May, Peter Freaerick William	Swansea	Wales
,,	Morrison, Leslie William	Mitcham	South Eastern
,,	Nation, Reginald Dennis	London	Eastern
,,	O'Neill, Hugh Roaerick	Rainham	South Eastern
,,	Rand, Leonard	Rayleigh	North Thames
,,	Smith, Anthony Gentry	Rickmansworth	North Thames
,,	Winale, Ronald	Sowerby Bridge	North Eastern
Second	Adams, Robert William	London	South Eastern
,,	Anwari, Arif Karim	Karachi	
,,	Apps, Peter	Asnford	South Eastern
,,	Bennett, Francis Richard	Greenock	Scottish
,,	Bickel, Reginald Freaarick John	Exeter	South Western
,,	Bone, Ronala William	London	Eastern
,,	Brown, Thomas Henry Walter	London	North Thames
,,	Burke, Charles Henry	bromley	South Eastern
,,	Butcher, Raymond	Worthing	South Eastern
,,	Cattell, Dennis Thomas James	Scunthorpe	East Midlands
,,	Chittick, Leslie Samuel	Sheerness	South Eastern
,,	Collins, Peter Freaerick	Maidstone	South Eastern
,,	Collyer, Paul James	Hythe	South Eastern
,,	Cropper, Ronald Frederick	Manchester	North Western
,,	Curtis, Stuart	Buae	South Western
,,	Cuthbertson, Thomas Turnbull	Bournemouth	Southern
,,	Donovan, John Michael	Cardiff	Wales
,,	Foad, Clifford Thomas	Canterbury	South Eastern
,,	Gane, David Thomas	Bath	South Western
,,	Hayes, Royston Arthur	Weston-super-Mare	South Western
,,	Higgs, William George Edwin	London	North Thames
,,	Houston, James	Hamilton	Scottish
,,	Hudson, Geoffrey Thomas	London	North Thames
,,	Keenan, John	Newcastle-upon-Tyne	Northern
,,	Littlechild, Donald John	Grays	North Thames
,,	McGurn, James Edward	Newcastle-upon-Tyne	Northern
,,	MacKenzie, Donald Ewart	Dudley	West Midlands
,,	Maitland, Robert Duff Francis	London	North Thames
,,	Mannion, Charles James Hindle	Huddersfield	North Eastern
,,	Matthews, Charles Sidney	Gillingham	South Eastern
,,	Matthews, Horace Stanley	Sidcup	South Eastern
,,	Mundy, Roy Douglas	Cheltenham	South Western
,,	Nobbs, Dennis Wesley	Poole	Southern
,,	Peck, Bernard	London	North Thames
,,	Perry, Alfred	London	North Thames
,,	Powell, Maurice William	London	North Thames
,,	Ray, Eric Leslie	Enfield	North Thames
,,	Riddell, Frank Dyer	Cambusland	Scottish
,,	Ross, William	Edinburgh	Scottish
,,	Seed, Frederick	Maidstone	South Eastern
,,	Setterfield, John Roy	Hornchurch	North Thames
,,	Smith, Eric	Cwmbran	Wales
,,	Stevens, William Alfred Peter	Griffithstown	Wales
,,	Thomason, Benjamin Charles Henry	Coventry	West Midlands
,,	Thompson, Ronald Wallace	Hornchurch	North Thames
,,	Towner, Raymond Cyril	Canterbury	South Eastern
,,	Tucker, Sydney Francis	Bristol	South Western
,,	Walton, Ronald	Halifax	North Eastern
,,	Welfare, Alan Francis	Brighton	South Eastern
,,	Wright, Alan	London	South Eastern
,,	Wright, Leonard William	London	North Thames
,,	Yelland, Jack Stanley	London	South Eastern
,,	Young, James Merrick	Durham	Northern

CANDIDATES WHO HAVE SUCCESSFULLY COMPLETED SANDWICH COURSES IN GAS ENGINEERING

Royal Technical College, Salford

Production

Freeman, Robert Wallace
Gillard, Malcolm William
Hullah, Geoffrey
Johnson, Peter Melvyn
Larcombe, Richard Gerald
Prouse, John
Taylor, David Alfred
Wilkinson James Barry
Wilson, John Douglas
Woodward, Harold

Distribution

Eaves, Keith
Habgood, Leonard
Kilmurray, John
Mulholland, Paul
Wren, Bernard

Utilization

Anderson, Robert
Holmes, George
Horner, Derek Ralph
Hoyle, John Dixon
Mortimer, Neville
Nuttall, Robert Leslie
Rhodes, Keith George

College of Advanced Technology, Birmingham

Gas Engineering (Manufacture)

Billington, M. J.
Hammond, A. E.
Hoare, T. W.
Lewis, D. A.
Norris, J. D.

Gas Engineering (Supply)

Bell, B.
Bradley, D. E.
Eaton, J. F.
Loverseed, D. E.
Williams, J. G.

Westminster Technical College

Gas Engineering (Manufacture)

Baker, N. C.
Belsham, A. F.
Bolton, G. J.
Byfield, A.
Glover, T. D.
Laidlaw, R. A.
Parkyns, R. A.
Stephens, K. S. A.
Tidd, M. J.
Vincent, D. C.
White, E. G.

APPENDIX 3

THE INSTITUTION OF GAS ENGINEERS

COMPARATIVE STATISTICAL SCHEDULE OF THE 1959 AND 1960 EXAMINATION RESULTS IN GAS TECHNOLOGY (MANUFACTURE) AND (SUPPLY) AND IN GAS FITTING (NEW SYLLABUSES)

Examinations conducted by the City and Guilds of London Institute

Examination	1959				1960			
	First Class	Second Class	Failed	Total Sat	First Class	Second Class	Failed	Total Sat
1	2	3	4	5	6	7	8	9
Gas Technology (Manufacture)	4	10	4	18	1	2	1	4
Gas Technology (Supply)	9	11	11	31	9	18	14	41
Gas Technology (Supply) (Part I only)	122		87	209	171		62	233
(„ II „)	50		27	77	40		22	62
Gas Fitting—	Passes				Passes			
Intermediate Grade	635		667	1,302	713		549	1,262
Final Grade	493		472	965	565		420	985

APPENDIX 4

THE INSTITUTION OF GAS ENGINEERS

LIST OF DISTRICT EDUCATION COMMITTEES: 1959-60

District	Chairman	Honorary Secretary
Eastern	R. C. Wardell	R. J. Gavin, Eastern Gas Board, 121, Mill Road, Royston.
Irish	—	—
Lancashire	F. Litler, B.Sc.(Tech.)	H. H. Thomas, B.Sc., North Western Gas Board, Bloom Street, Salford, 3.
London and Southern	G. H. Kenyon, M.Sc.(Tech.) ..	A. H. Savill, M.Sc., South Eastern Gas Board, Katharine Street, Croydon.
Midland	E. T. Pickering, B.Sc.	C. P. Astbury, M.Eng., West Midlands Gas Board, Saltley Gas Works, Birmingham, 8.
Northern	W. Sutcliffe	F. J. Webster, Northern Gas Board, Thompson Street, Stockton-on-Tees.
Scottish	D. Beavis	R. J. Faulkner, Scottish Gas Board, 26, Drumsheugh Gardens, Edinburgh, 3.
South Western	A. Marsden, M.B.E., Ph.D. ..	J. B. Taylor, South Western Gas Board, 9A, Quiet Street, Bath.
Wales and Monmouthshire ..	A. Pickard	A. Pickard, Wales Gas Board, The Kingsway, Swansea.
Yorkshire	J. M. McLusky	P. H. Beahan, B.A., North Eastern Gas Board, Bridge Street, Leeds, 2.

PRESENTATION, DISCUSSION AND REPLY

Presentation

Dr. A. E. Haffner (Southampton ; Chairman, Gas Education Committee) presented this Report and said :—It is again my privilege to present, on behalf of my fellow committee-men, the Annual Report of the Gas Education Committee.

The Advisory Committee on Education and Training to The Gas Council has very commendably met by correspondence only, but liaison between The Gas Council and the Gas Education Committee of the Institution has been maintained regularly by the attendance of Dr. A. B. Badger and Mr. R. D. Moyle at meetings of the Committee. In this way, there has been an interplay of influence that has been all to the good as we have worked in our separate fields of activity.

There are several references to the lectures for young people, and more and more young people have been instructed and entertained in more and more localities. The lecturers concerned have derived a special sort of satisfaction from their efforts. These Christmas lectures are now flourishing so well that the impression might be created that they have become a dominant part of our work. They have an important and subtle influence, but they are a fulfilment of only part of our purpose. It may be that I am claiming too much credit for our " Flame " lectures when I report that the Michigan Consolidated Gas Company has now staged a highly polished show of a similar sort under the name of " Gasarama ".

Quite a new venture for us has been the Short Refresher Course for Engineers. It was designed to enable station engineers and their deputies and similar people from the contracting side to meet under conditions of mutual stimulation and under the provocation of some quite arresting lecturers.

The course was strenuous, but successful, and everyone present contributed to the success. We enjoyed the goodwill of the College and are grateful to Area Gas Boards and to contracting firms for releasing key men to deliver expert lectures ; to Sir Dennis Proctor, K.C.B., and Sir Henry Jones, M.B.E., and, of course, the then President, for their interest and attendance, and to Mr. W. K. Hutchison, C.B.E., for the original idea.

Much was learnt in this first course, and another one of the same type, but with some improvements incorporated, meant for equivalent ranks of engineers engaged in gas distribution or by contracting firms will take place between 9th and 15th April, 1961. Utilization engineers, who, perhaps, could more urgently benefit from such a course, may wonder why their turn has not yet come. This has been influenced by the fact that there has, in the meantime, been organized, by Mr. R. J. Hayman, Industrial Gas Officer of The Gas Council, a first-rate course for industrial gas engineers to study in high detail the relevant Gas Council Research Communications that have been presented to this Institution. Although this course was treated rather differently from the way in which we should have covered utilization engineering, there was sufficient similarity for it to have been wasteful had our course followed so soon.

Sandwich Courses at Salford, Birmingham, Enfield and Westminster, and a similar course at Heriot-Watt College, Edinburgh, continue to be important for the flow of students who, in all the three years combined, numbered about 160. Mr. A. F. Gram, an assessor, will contribute to this discussion. Appendix I to the Report is a recommended programme for practical training, and it is an outcome of opinions expressed at a conference called in an earlier session (January, 1959) to discuss with the Principals and heads of departments of the Technical Colleges affected the indirect effect of our change of Associate Membership syllabuses on Sandwich Courses. Many attending the conference saw the need for closer fusion and integration of the practical and theoretical training phases. Subsequently, there were requests, from those concerned on behalf of Gas Boards that had not yet seriously taken up Sandwich Courses, for guidance in the practical training. What is now offered is no more than guidance, but it is the outcome of long argument amongst the members of a panel chosen for their special experience in this field. It is not to be expected that everyone will agree on such a controversial subject, but already we have heard that the guidance is appreciated.

Reference is made to Allen's course for engineers, which is now in operation at Bedford to the benefit of six young engineers from the gas industry. The course is on a modest scale, but its accumulative effect must have led to a greater appreciation of the fine machines made by British engineering firms. In exchange, the students must have brought to Allen's a greater awareness of the operating problems on site.

In this context, I should like to refer members to the Report, available in the Library, that Mr. A. G. Higgins produced after taking part in the Swiss tour organized by the London and Home Counties Regional Advisory Council for Technological Education, during which a study was made of engineering training for apprentices and graduates. To the Swiss, the need to convert imported material into high-quality engineering products is even greater than in any other country, and their training programmes reflect this.

The Associate Membership Examination continues to be our principal *raison d'être* both for its own sake and for the implied standard by which Sandwich Courses are judged. Let me say in a clear and loud voice that the revised syllabus will be operative from the Associate Membership Examination in October, 1962. This warning has been made each year for the last few years. The last examination on the old syllabus will be April, 1962, and the two systems will not overlap. The Associate Membership Examination in the first and/or second paper was undertaken by 58 candidates. The numbers taking internal examination by Sandwich Courses at Salford, Birmingham and Heriot Watt College numbered about 40. This indicates that the Associate Membership Examination still has a direct, dominant importance as well as an indirect one.

There are so many people, all of them busy in their important work, who are ready to spare precious time and energy to devote to education and training activities ; they will forgive me for not referring to them by name. In spite of this, I feel compelled to refer, once again, to the exceptional contribution made to the work of the Gas Education Committee by Mr. A. G. Higgins, our Assistant Secretary.

Discussion

Mr. L. F. Randall (Leicester) :—Dr. Haffner has asked me to comment on Section IV of the 37th Report of the Gas Education Committee, which deals with the work of the Sales Training Committee and is, of course, part of the Institution's education scheme.

It will have been noted that, although there is a slight reduction in the number of candidates who sat the written examination for the Certificate in Gas Salesmanship and Consumer Service, the standard of the candidates was found to be higher than in previous years. This, I consider, is significant, because it means that more of our younger sales and service employees are being infected with some of the enthusiasm that exists throughout the commercial side of the industry at the present time ; this is reflected in their approach to their studies. The only disturbing feature is that the number of young men studying under the Institution scheme appears to be extremely small in relation to the requirements of the industry as a whole. Admittedly, many Area Gas Boards are now concerning themselves to a much greater extent with the training of their staff, but most of their courses are of short-term duration and generally concentrate either on the sales or the service aspect of their business.

I suggest, however, that any young man who works through and is instructed in the complete syllabus laid down by the Institution for its Certificate in Gas Salesmanship and Consumer Service, and eventually passes the examination, will be known to have received a balanced course of instruction covering all the basic aspects of sales and service techniques. The employee is then in an extremely satisfactory position to receive further intensive training on any particular subject closely associated with his day-to-day work.

The Report refers to the new syllabus to be used for future examinations, and to the fact that these syllabuses integrate for the first time with the main subject the necessary ancillary subjects, such as mathematics, engineering science and engineering drawing. This is a major change, but my Committee considers that it will help materially. The change has the advantage that all instruction will in future be carried out under the guise of gas technology and the teaching of mathematics, science and drawing will in the main

be associated with actual problems relating to the utilization of gas. The student will then understand much more readily the need for adequate knowledge of these ancillary subjects and the way in which they support the main subject of gas technology.

The Report indicates, however, that we have not treated the ancillary subject of English in a similar way, because it is felt that English cannot easily be worked in with a technical subject, and it is recognized that unless a student is competent in the art of self-expression he can never become a good salesman. The question of literacy has been much in the public mind during the past few weeks, and it would appear that the accepted standards vary to a much greater degree than most of us realize. However, my Committee considers that to be effective in his job as a salesman a candidate should reach a desired standard of literacy and be able to express himself precisely and adequately.

While most of the technical colleges provide courses in English, the subject matter covered by these courses is by no means standard and can vary, for example, from a study of commercial English to a study of English literature of the Middle Ages. Both, however, are classified under the heading of English. My Committee considers that instruction in the art of self-expression is so important that it is desirable to add to the new Educational Regulations a syllabus that lays down its own requirements and covers the use of the written and spoken word in the full business context.

I should like to express my appreciation of the work done by my Committee in respect of these proposals, and also to acknowledge the help we received from all our examiners, who give so much of their personal time in forwarding the interests of the Institution's education scheme.

Mr. J. Maitland-Edwards (H.M. Inspector ; Technical Education) :—It is a pleasure for me to be present again, and I would like to start by giving apologies from my colleague, Mr. F. Caunce, who is, unfortunately, unable to be present owing to his absence in Belgium.

We are glad to see the importance the Institution attaches to the lectures for young people. There is always a feeling, when anybody from the Ministry of Education speaks, that he may be a long-haired theoretician, but we are equally aware with yourselves of the importance of quality and quantity of raw materials. You have heard about the " bulge " almost *ad nauseam*, but it is very important to realize that passing through the upper stages of the schools at present is a potential that must be made full use of if this country is to go ahead in a sound economic fashion in years to come. This was brought home to me very strongly in Germany last Autumn, when I heard Germans bemoaning the fact that their " bulge " had passed and they were not now able to recruit into industry the numbers of young people they would like. They were envying Britain its position in the next few years, when we shall have available a larger number of young people than have existed for many years and than will for some time exist in the future.

To put this in perspective, the numbers of the 18-year-old age group at the moment are the smallest that we have had in this country for many years, but we are about to start to mount to a " bulge " in two peaks, the main one coming in the mid-1960s, when the size of the 18-year-old age group will be approximately 50 per cent above its present size. This is not a lasting phenomenon, but a peak. We think that there are other factors, besides the peak, that will influence the numbers coming into professional qualification training at the age of 18, factors such as the trend to stay longer at school, and so on.

So we are particularly glad to see the stress that has been laid on the lectures for young people at this stage, when the peak is still in the schools.

We are glad to see, further, the attention paid by The Institution of Gas Engineers and other professional bodies to setting their educational houses in order in readiness for the young people coming out in the mid-1960s into professional training. It is particularly heartening to see the work done by this Institution in drawing up a scheme of recommended practical training in the works. We are convinced that, unless young people are fired with the importance that is attached to this work by the practising engineer, they will consider that it is a soft option. They may tend to float through a course, rather than to work hard. In fact, we have some evidence of this in the examiners' reports, and I have marked one or two points, for instance :—

" The gas engineer must have a good grounding in these basic technologies, but requires a considerable amount of practical knowledge and experience that are peculiar to gas alone. The acquisition of this practical knowledge and experience must, therefore, depend on the enquiring mind of the candidate in his daily work. There was evidence in the papers to indicate that the thirst for knowledge was either not there or had been easily quenched."

These words constitute an indictment of somebody or some organization, and I think it is up to all of us to see that the valuable raw material coming forward in the 1960s is stimulated and not quenched. We from the college side will do all we can to provide the enquiring mind, but it is very easy for somebody in authority in the works to brush young people aside or not to be deliberately stimulating. I am convinced that all of us will wish to foster the enquiring mind, but unless we do so deliberately we may well extinguish the spark.

I have been briefed, by the Chairman of the Gas Education Committee, to speak shortly on the short course for teachers. I have opened on a more general note because I feel that it is a very important note. I am pleased, however, to speak of the arrangements made at Southampton last summer, when I had the privilege of being present for a day, and to speak further of the tentative arrangements for the coming summer of 1961. Mention has been made, by the Chairman of the Sales and Training Committee, of the integration of subjects, which is taking place in the qualifications on that side. This integration is also taking place for gas fitting, and there is evidence that many of the teachers who have in the past so valiantly served on a part-time basis for the training of gas fitters are finding difficulty in providing the integrated approach. It is a long while since they did any science. I shall not say that their calculations are at fault, but it is a very different matter to teach science in a course in gas fitting than to have the students take the course in science and then present themselves for gas fitting.

At Southampton, much of the valuable work performed by the Southampton Technical College was not fully comprehended by the teachers. They gathered very much, but, nevertheless, even after the course they would not have been able to teach science reliably in gas fitting instruction. This is in no way a criticism, but merely the statement of a fact. At present, there is a dearth of teachers who can adequately teach science integrated with the technology, and we may come across the same position when the new schemes for sales training come into full effect. We may find that there are people who are well qualified to teach the main subject, but who find themselves very rusty when they come to integrating the ancillaries with the main subject.

With this in mind, we are focusing attention on the need for science in courses and on the courses for teachers, and while, for the coming summer of 1961, we are not proposing a course for teachers of gas fitting, we have in mind for future years further courses to enable the teachers of gas fitting to bring themselves up to date with the presentation of science in their courses.

In the coming summer, the proposal from the Ministry side, backed by The Institution of Gas Engineers, is for a course for teachers in gas technology. We are having a little difficulty in finding a suitable location, not because of any unwillingness of Area Gas Boards, but because of the problems of residential accommodation. My colleague Mr. Caunce is in touch with several organizations, and I have little doubt that, probably before Christmas, it will be possible to arrive at a definite decision as to where the course will be held.

A further aspect of teacher training that is concerning us at present is the need to keep teachers fully up to date with the technological situation and with trends in industry. There was a further point in the examiners' report that gave me to think about this. There is the statement : " One wonders how many candidates have the opportunity to see manufacturing costs ". We hope that not only will they see manufacturing costs in the works, but also the structure of costs ; the relative significance of different costs will be brought out in the teaching at the colleges. To do this, the teacher must have access to such figures. There is a further statement : " There were distinct indications that candidates had obtained their knowledge from textbooks or from tutors not abreast of modern developments and nomenclature within the industry ". We take this much to heart ; we had not expected this sort of comment at this stage. It is indeed a strange situation if

teachers from the industry are not abreast of modern developments and nomenclature within the industry. I am wondering how far this still reflects, in nomenclature, variation from one part of the country to another. We are aware, however, that the time will come, with the growth of Sandwich Courses, when full-time teachers will tend to become rusty. We are very anxious that we shall be able to develop, in association with the industry, schemes for secondment of these teachers back to industry to keep themselves abreast of developments.

For the more well established full-time courses in science, we have arrangements whereby small numbers of teachers spend six weeks each in industrial laboratories. In the last four years, 34 teachers have in this way attended for refresher periods or, for those graduates who have not served in the industry, for an eye-opening period. We hope that in the future it will be possible to evolve some such scheme in association with the industry.

It will have been gathered that we attach very great importance to firing young candidates with enthusiasm, and in the teachers themselves to the maintenance of standards well abreast of the industrial situation. We regard the teachers as the seed corn for the future, and I am fully aware that your industry does likewise. By joint working, I am sure that we can assure satisfactory teaching for the training of the technologists of the future in the gas industry.

Mr. F. Grocott (Birmingham) :—As Chairman of the manufacturing panel of the Board of Examiners, I feel that it would be appropriate if, in addition to emphasizing some of the points made in our report, I were to say a few words about the work and composition of the board.

It consists of 12 members, four of whom retire each year, to be replaced by four new members bringing new ideas, and serving for three years. Half the members are on the manufacturing side and half on the supply side of the industry. There are three meetings a year. Two of these meetings are chiefly concerned with the preparation of papers for the April and October examinations for Associate Membership, and the third meeting with the approving of the Board of Examiners' annual report, which is contained in the Report of the Gas Education Committee. At this third meeting, there may also be oral examinations of candidates for the Charles Hunt Medals and for borderline first-class passes.

Though the members of the board are keenly interested in education, they may not have had actual teaching experience in gas engineering subjects, and the first year is often one of adjustment to the policy of the board and the acquiring of experience in the setting of questions and the marking of papers. The friendly arguments between members of the board as to the relative merits of questions, the exchange of information and views between members who come from all parts of the country, the stimulating effect of revising knowledge and (should it be mentioned?) acquiring knowledge, all these make membership of the board a very pleasant experience and result in a feeling of regret when the three years end.

I should like to make a few comments on the examiners' report, in which they comment that the answers to questions suggest that students are not benefiting from their works or practical experience as much as is desired. It is therefore of interest to study the recommended programme for practical training of Sandwich Course students. The sections headed "Purposes of Practical Training" and "Outline of the Model Programme" might well be duplicated by every Area Gas Board and circulated to all section chiefs who might be in any way concerned with the practical training of Sandwich Course students and/or candidates for the Associate Membership Examination.

The question is asked: "How often is a student treated as a holiday relief or as a means of mitigating temporary or even permanent shortages of staff?" How often is a student given routine work that leaves little time for widening his practical knowledge? Examiners endeavour also to test students' knowledge of recent literature. This has some bearing on the remarks of the previous speaker, and there is evidence that students do not keep abreast of modern developments. I would ask whether junior engineers see the weekly publications of the gas press, or do these periodicals mount in an ever increasing stack on a senior official's desk until he can find time to glance through them? Are students allowed time to read publications during working hours?

On behalf of the members of the manufacture panel, I should particularly like to express our appreciation of the very helpful advice and constructive suggestions that we receive from Mr. E. T. Pickering and Mr. G. H. Kenyon, the Gas Education Committee representatives, and from Mr. A. F. Grant, the assessor for Sandwich Courses. These three gentlemen attend our meetings and ensure continuity of policy and maintenance of the standard of the questions set by a board that annually changes one-third of its membership. I should like also to take this opportunity of thanking Mr. A. G. Higgins, the Assistant Secretary, and Miss S. Musk of the secretariat staff, for their very valuable help when acting as secretaries to the panels.

Mr. A. D. Graham (Deputy Director, City and Guilds of London Institute) :—References to the City and Guilds of London Institute examinations, both present and future, are frequent in the Report, pages 84, 85, 86, 91 and 92 of which make eloquent reading. The conclusions to be drawn are fairly obvious, and in some cases all too obvious. I am pleased to be able to speak not only as a member of the Gas Education Committee, but, as a representative of the City and Guilds of London Institute responsible for many subjects in the scheme of its examinations, I propose to refer very briefly to those of its subjects that affect the gas industry either as stated in the Report or as they will be, and with which many members of the Institution are concerned in one way or another. Many of our advisers are present today. The subjects are, on the manufacture side, Gas Manufacture Practice—a new scheme; on the distribution side, Gas Distribution Practice—a new scheme; and on the utilization side, Gas Technology (Utilization), the comprehensive revision of which has just been completed; and I shall refer to Gas Fitting, now comprehensively revised. Just as it has been a busy year for the Gas Education Committee, so it has been for the City and Guilds of London Institute so far as gas subjects are concerned.

The Gas Manufacture Practice and Gas Distribution Practice schemes, which are in an advanced stage of preparation, and the Gas Technology (Utilization) scheme, represent in total what is hoped to be a realistic revision of the syllabuses in Gas Technology (that is, the erstwhile Gas Manufacture and Gas supply schemes) at sub-professional levels.

It will be recalled that the revision of the syllabuses in Gas Technology as a whole has been considered for some time. The reference in the Report to the revision of the Institution's syllabuses includes also mention of the fact that the City and Guilds of London Institute, through its advisory committees, has been considering the revision of the regulations for its examinations in Gas Technology (Manufacture) and (Supply). As stated in the Report, it is now proposed to offer separate examinations at appropriate levels in Gas Technology (Manufacture), Gas Technology (Distribution) and Gas Technology (Utilization). In the case of Gas Fitting, it is proposed to dispense with separate ancillary subject examinations and to incorporate into comprehensive syllabuses all of the technology and associated subjects required. To elaborate this briefly, it can be said that the City and Guilds of London Institute was not happy about the schemes as they existed. In particular, Gas Technology (Manufacture) seemed to be inadequate or inappropriate, judging by the poor response. In recent years, the number of candidates have been little more than a mere handful, and reference to the Report will prove this. In Gas Technology (Supply) the position has been better, and especially is this true in connexion with Part I—Domestic Utilization of Gas. This, of course, is due to the fact that Part I could be taken separately in connexion with the Certificate in Gas Salesmanship and Consumer Service of the Institution, and is accepted for this purpose.

The new proposals are that there should be three lots of examinations, that is (i) in Gas Technology (Manufacture), (ii) in Gas Technology (Distribution), and (iii) in Gas Technology (Utilization), in an attempt to make the courses far more in keeping with current needs within the industry.

On the manufacture side and on the distribution side respectively, the new Gas Manufacture Practice and Gas Distribution Practice schemes are approaching finality. The Advisory Committee has not found the alteration easy and has experienced considerable difficulty in arriving at what it believes to be appropriate curricula and syllabuses, having in mind the personnel for whom these examinations would be suitable. The proposals have, therefore, been given a wide circulation and observations have been invited. To those who are interested and affected, may I urge that these

proposals be given very serious consideration and submit your comments, if possible, by the turn of the year.

Very briefly, the Gas Manufacture Practice scheme is intended to provide a vehicle for training and education in the practice of Gas Manufacture. The scheme is intended to provide for operatives in the gas industry : firstly, as a means of obtaining a wider knowledge of the processes of gas manufacture as well as an understanding of the principles, and secondly as a qualification. The operatives for whom the scheme is envisaged are works supervisors, foremen, assistant foremen and the operators of gas works plant such as carbonizing plant, water gas plant, oil gas plant, purification and benzole-recovery plant, boilers and power plant. At the same time, the scheme should provide a useful technical background for clerical staff whose work is related to gas manufacture. It is envisaged that the course will be of about 200 hr duration, and there will be a single examination paper of 3 hr duration. There will be no separate syllabuses for ancillary subjects, as it is intended that instruction in these subjects should be integrated into the syllabuses for the main subjects.

The Gas Distribution Practice scheme is intended for operatives engaged in the distribution of gas, that is, from gasholders to the consumers' meters. It is intended for such employees as distribution foremen, mains and service laying gangers, main layers, joiners, service layers, valve and governor maintenance men, and holder station attendants, and also, once again, for clerical staff engaged in the departments of distributing engineers. The format of the scheme follows closely that which I have outlined in connexion with Gas Manufacture Practice.

The new Utilization scheme has now been completed. It is intended to provide education in the technology of Gas Utilization and also examination qualifications for operatives and staff in the gas industry. The examinations are to be conducted at two levels, Intermediate covering the domestic utilization of gas and coke, and Final, which includes commercial and industrial utilization of gas. The first examinations are advertised to be offered in 1962. I emphasize that they are advertised to be taken in 1962, but we have recently received evidence that there are sufficient candidates coming forward perhaps to justify the introduction of the examinations in 1961. The City and Guilds of London Institute is actively considering this matter, and its decision will be made very soon.

This Gas Utilization scheme, as a whole, follows naturally from the examinations of the Institute in Gas Fitting. It is, therefore, considered suitable for such employees as gas fitters wishing to progress further, as well as district representatives, salesmen (domestic, commercial and industrial), and for clerical staff engaged on sales and service work.

A feature of this scheme, too, is that there are no separate syllabuses for ancillary subjects, because it is intended that instruction for such subjects, to the necessary standards, should be integrated into the syllabus for the main subject. The syllabuses have, therefore, been set out in such a way as to relate the ancillary subject matter to the main subject as appropriate. This relation is given for guidance and not necessarily for rigid adherence. The examinations at the end of the intermediate and final courses within the scheme will be designed to test the candidates' knowledge both of the main subject and of the associated ancillary subjects.

Finally, on the subject of Gas Fitting, we have recently published the revised scheme of syllabuses, and those who are interested will have doubtless received copies. The scheme has been approved by the National Joint Industrial Council for the Gas Industry for the purposes of the National Classification Scheme for Gas Fitters. It is a five-year part-time course with a suggested attendance for 180 hr of study in each of the years. The intermediate grade examination is to be taken, normally, at the end of the third year, and the final should be taken after two further years of study beyond the intermediate grade. Candidates should be 18 years of age before attempting the intermediate examination, in order to ensure adequate experience on the district.

The scheme is characterized by the closest co-operation between Technical Colleges and the Area Gas Boards on whose premises the practical examinations are usually conducted.

Syllabuses as set out represent a completely new approach to the teaching of Gas Fitting ; whereas, previously, calculations, science and drawing were treated as separate subjects, the revised syllabuses include the aspects of these subjects directly related to the work of the gas fitter and necessary for his understanding of the course under the single title of " Gas Fitting ". Unrelated associated topics have been eliminated.

From all I have said, it will be realised that the new approach in all these courses is based upon a confident hope that sufficient guidance has been given to teachers, in consultation with industry, to enable them to bring to bear what is really needed by the industry and by technical education as a whole.

It only remains for me to take this opportunity to thank all those who have served on the several Advisory Committees and Syllabus Sub-Committees. I should be failing in my duty if I did not pay particular tribute to The Institution of Gas Engineers and also The Gas Council for their willing co-operation at all times.

Mr. A. F. Grant (London) :—My interest in the discussion on this Report is as the assessor for Sandwich Courses in Gas Engineering (Manufacture). Whilst I do not presume to speak also for my colleagues who are assessing the Distribution and Utilization courses, I do know that they agree with at least a number of the points I should like to make.

We are well aware of the responsibilities we carry. Primarily, we serve the College providing the Sandwich Course, but we are conscious that we, at the same time, serve the Institution and the gas industry in endeavouring to assess conscientiously whether a particular student has the theoretical and practical ability to become a useful member of both the Institution and the staff of any organization in the industry.

From figures kindly supplied to me by the Institution, it is seen that in each of the last two years some 50 students have been elected to Associate Membership, having qualified through a National Certificate course, while nearly half that number have qualified through Sandwich Courses. The annual number of new Student Members of the Institution shows a fairly constant level in each of the last three years of about 12 studying for the Higher National Certificate and 45 in Sandwich Courses. The latter are spread over three- or four-year courses. It is probably safe to assume, however, that there are now equal numbers from each source qualifying in any one year and becoming Associate Members of the Institution. Hence, there is a trend towards a greater intake to the industry in the future from Sandwich Courses ; a trend that might well accelerate.

In passing, it is pleasing to note a considerable increase this year in the election to Associate Membership of men with University degrees—24 compared with an average of 14 for previous years. It is suggested, however, that, with the probable developments in the industry in the immediate future, it can ill afford to neglect recruitment from either source. The assessors do not, nor do I think do the Colleges, regard the Sandwich Course product as an inevitable second best to the degree man. This point and the general development of Sandwich Courses has been covered admirably by our Assistant Secretary in his address to the London and Southern Junior Gas Association in March, 1959.*

The main problem of the assessor at the present time is that the amount of knowledge acquired on all subjects in the existing intensive and few short periods at College is inadequate. The presentation and content of the work in examination scripts is immature, and the assessor finds it difficult to determine whether a candidate will ultimately develop into a capable engineer. The assessor's implied obligations to the Institution and to the industry then become onerous.

There is, therefore, a vital need to reach an urgent decision on the up-grading and extension of one or more of the Sandwich Courses.

Nevertheless, there has been material improvement in the existing Sandwich Courses, arising from the efforts of the staffs of the Colleges and to their very willing co-operation with the personnel of Area Gas Boards and with the assessors in reviewing both the theoretical and practical aspects of the courses. Proposals are under discussion for the closer integration of a student's practical work with his College studies, and, to overcome the problem of immaturity, as I have called it, for a closer contact between the student and the assessor.

With the hoped-for extension and up-grading of the courses, the appropriate extension of lecturing facilities is a necessary

* Education and Training for Gas Engineering. Higgins, A. G. *Gas J.*, 1959, 297, 494.

corollary. The present system of practising engineers from the industry lecturing at the Colleges as part of the course may need also to be enlarged ; the industry must be ready at all times to offer the best facilities that it can in this respect. A movement is now starting in the reverse direction to keep the permanent lecturers of the Colleges abreast of development ; this requires to be fostered by the industry.

It is indeed pleasing to learn that gas engineering students at the Heriot-Watt College are comparing favourably with students in other faculties. It is essential that a sound mechanical and chemical engineering background be ensured by the insistence on a high level of attainment in the ancillary subjects of the course.

Goaded, possibly, by the frequent bewailing of assessors at the inadequate practical knowledge shown by Sandwich Course students, the Institution set up a Sub-Committee to consider this matter, with the result shown in Appendix 1 of this Report. My protestations in this connexion rebounded, since I became involved in the preparation of the recommended programme. The essential need for flexibility in the plan of training to suit all circumstances may belie the value and importance of the recommendations made and the use that can be made of the plan ; for example, the means of introduction of a student from school to the industrial atmosphere is vitally important. Hence the proposals for a first period in the drawing-office or laboratory. The conception of engineers as mentors to the student engineers, as proposed in Section 3 para (IV) of Appendix I of the Report is of great importance. These mentors could ensure the proper maintenance of the log book system with maximum benefit to the student. A great deal of thought, work and, indeed, friendly argument went into its preparation, and I commend it to serious study by all who have training responsibilities.

I speak as one who has these responsibilities and, therefore, knows the difficulties and who at the same time sees, through examination scripts, the results of practical training, or lack of it, that is given.

Making allowance for the students' immaturity and short time of contact with works plant, it is a fact that there is frequently little appreciation of, say, day-to-day retort house control, or the reasons for keeping a log sheet for a carburetted water gas set. The flow diagram of an ammonia liquor concentration plant can be memorized from lecture notes for examination purposes, but how the controls function to maintain automatic operation is a complete mystery. The student may argue that a sound knowledge of mechanical or electrical engineering plant design and operation need not be acquired if he is prepared to gamble on a high pass in the gas engineering questions. Similar circumstances apply, I believe, in the case of distribution and utilization students.

The time of the student at College is planned to the last minute, and hordes of lecturers pump knowledge into him continuously to complete the syllabus. Is there not a similar case for the organization of practical training ? And can the normal works personnel alone undertake this ? At what level do we rate our investment in this new material coming into our industry ? Do we obtain the maximum dividend ?

Mr. D. L. Hill (Poole) :—To the possible disappointment of those colleagues who know my heretical views on the value of the Certificate in Gas Salesmanship and Consumer Service, I propose to concentrate on my other hobby-horse, namely, " Realism in Training ".

Firstly, I should like to congratulate the Chairman of the Gas Education Committee, Dr. A. E. Haffner, on the air of realism that seems to pervade most of his Report. This was exemplified in the Short Refresher Course for Engineers, at Oxford. The Report says itself that the purpose of the course was not to provide a forum for highly-specialized papers, but to offer engineers an opportunity of exchanging views and experiences.

This air of realism is borne on throughout the sections of the Report dealing with the " Flame " lectures, practical training for Sandwich Course students, and right into the new Gas Fitting syllabus, where multi-points have replaced mathematics and theorems have given way to thermostats.

Again, a realistic approach was attempted by requiring the teachers of gas fitting to lecture on their short course. This, however, is where I should like to slow down a bit, as something seemed to go slightly wrong here. If part of a course misfires, I hold that it is probably the session itself that is at fault, or the students, and in this case I would suggest that it was both.

Participation is a good thing in training, and the idea of introducing an air of realism through practical sessions was wholly praiseworthy. However, I suggest that it would be better, on future occasions, to integrate the practical exercises into the course rather than to have a completely separate section lasting for 2½ days and consisting virtually of nothing but students lecturing to each other.

Turning to the students themselves, I hope that I am not being too uncharitable when I express the view that there appeared to be far too many part-time and far too few full-time professional instructors on the course. I realize that, in raising this criticism, I may be indirectly criticizing the organization of gas fitting training in those places where it is still mainly carried out by part-timers. However, the ratio of part-time to full-time teachers throughout the industry stands at 2 to 1. Although this ratio has improved from 3 to 1 since 1958, the time has now surely come when we can all rationalize our gas fitting training and, as a result, employ full-time instructors, or, better still, get the Technical Colleges to do it for us. Professionalism and expertise in training, as in most things, are desirable.

Chairman's Written Reply

Dr. A. E. Haffner (Chairman, Gas Education Committee), in reply, wrote :—The contribution by Mr. Randall really amounts to a presentation by the Sales Training Committee in its own right. Mr. Randall focuses attention on the adaptations made to the course so that sufficient competence is attained in mathematics, science and drawing without the student being quite conscious of having been so trained. Particularly in the field of sales and service, there is an importance in the proper use of the spoken and written word to convey meaning accurately and persuasively. Rightly, Mr. Randall stresses literacy, and in his own contribution has used words well to " sell " the courses with which his Committee is concerned.

It is always refreshing to have the views of Mr. Maitland-Edwards, expressed so eloquently and with a background of considerable experience outside our industry. The Ministry of Education is beginning to feel the relief that the " bulge " has been almost dealt with in its own educational systems, and rightly he warns us to make good use of this single and not-to-be-repeated tidal wave of available youth. I am pleased that Mr. Maitland-Edwards finds in some of our activities a commendable attempt to capture the interest of young people and to provide suitably integrated practical training courses for those that decide to join our ranks.

We are grateful for the references to the Short Course for Teachers held at Southampton Technical College, and to the misunderstandings from some of the teachers of the advantages to be gained by the incorporation of ancillary science subjects into the main subject. This has been done, for example, at Southampton with outstanding success. It is wise for the inspectors to be thinking in terms of helping teachers in gas fitting, by concentrating on the presentation of science in their courses. In the meantime, many teachers of gas technology will be pleased to hear of the arrangement being made for a course for them.

At an earlier conference devoted to the scrutiny of Sandwich Courses and the communication between the industrial and academic layers, there was a widely held view that more exchange of information, visits and even jobs would ensure that the teachers were well versed in modern gas engineering and that those in industry were sufficiently ready to satisfy the awakened curiosity of the students as they transfer from College to works. If this sort of interchange does not soon develop satisfactorily by local arrangement, it may need some concerted attempt to encourage it to take place.

Mr. Grocott, speaking as Chairman of one of the panels of the Board of Examiners, describes their tasks, and, in spite of the tedium of much of it, he still finds it pleasant and a matter of regret that his term of three years' labour is ended. Of such stuff are examiners made, and, if that were not so, our educational activities would never have been so successful. Mr. Grocott refers also to the practical training of Sandwich Course students and to the risk of them being disregarded. Perhaps the model programme will help to stimulate interest in the student's requirement and to

make his practical training a matter of personal responsibility on the part of the engineers to whom he is entrusted.

We appreciate the contribution of Mr. Graham all the more because we, too, have just emerged from the difficulty of re-organizing our own educational scheme.

The City and Guilds of London Institute has traditionally concerned itself with training at sub-professional levels, and now it has, after a period of contemplation of the changing circumstances, sought to adapt itself by adjusting its curricula. Many of us are aware that widespread and thoughtful examination of the proposed changes is going on. We are grateful to Mr. Graham for so clearly reviewing in detail the objects of the proposed changes and the people they are intended to attract, and we trust that he will gain valuable guidance from those to whom the proposals have been submitted for examination.

Mr. Grant, an assessor for Sandwich Courses, refers to the changing trends in the routes chosen to gain Associate Membership—by National Certificate route, Sandwich Course route, and from the Universities.

He finds that, as an assessor, there is a vital need to decide on an up-grading of one or more of the Sandwich Courses in order the better to enable a student to develop ultimately into a capable engineer. This decision certainly needs to be faced and it will be possible to do so when the industry has decided what are its needs and when the Colleges can decide how this can be done in the most effective way without waste of educational facilities. The Institution is ready to play an appropriate part in helping to make these decisions. The matter grows in urgency.

Mr. Grant speaks with direct experience of the practical training of pupils or students, and for this reason he was one of the panel who prepared the model plan for the guidance of those responsible. It is not likely that this guidance will be necessary to those Area Gas Boards with extensive experience in the practical training of Sandwich Course students, but the aim is to help to make standards uniformly good throughout the industry.

Mr. Hill's first sentence implies that he has only two hobby horses instead of the extensive stable of hobby horses that some of us know him to maintain. Realism in training is specially important the more dominant becomes the practical aspect of a man's work, and perhaps the best example is the training given to main and service layers in Mr. Hill's " Battlefield " course and similar ones in the industry. Mr. Hill and his colleagues were directly involved in the Short Course for Teachers at Southampton, and his comments on the misfire in one session appear to confirm what Mr. Maitland-Edwards and Mr. Caunce are intending to do in future courses where emphasis will be placed on the presentation of science by lecturers who have previously been able to rely on someone else to clear up ancillary subjects.

Members of the Gas Education Committee will profit by all the ideas, explanations and criticisms presented by those participating in the discussion, and I express our thanks for the stimulation to our educational work.

In this Issue...

A. E. Haffner

Dr. A. E. Haffner, Chairman of the Gas Education Committee, was born in Burnley in 1907. He left Burnley Grammar School in 1924 to become articled pupil to the Public Analyst and Gas Examiner at Burnley Gas Works. He was at the Royal College of Science from 1926 to 1929, gaining first-class honours in chemistry. At the Imperial College of Science and Technology (1929 to 1932) he carried out research on combustion of methane with oxygen under high pressures. In the last two years he held the Gas Light and Coke Company Fellowship. In 1932, he joined the Research Department of The Gas Light and Coke Company, and worked mainly on development work on full-scale carbonizing and gasification plants, which was interrupted in 1936-37 by the award of the first Arthur Duckham Memorial Fellowship, used to carry out research work on combustion characteristics at the Gasinstitut, Karlsruhe, and to make a European tour of fuel plant and research centres. In 1940, Dr. Haffner became an Assistant Engineer at Nine Elms ; in 1946, he was appointed Station Engineer, later Group Engineer, Fulham, and in 1956 moved to the Southern Gas Board as Chief Engineer ; three years later, he was appointed to be a Member of the Board. He is currently Junior Vice-President of The Institution of Gas Engineers, and has been associated with the education work of the Institution, in one form or another, for more than 20 years.

G. M. Rimmer

G. M. Rimmer served an indentured apprenticeship in engineering at Pilkington's Glass Works, St. Helens, and was subsequently engaged on research and the development of toughened glass. In 1933, he joined the technical staff of J. A. Jobling, Pyrex Glass Works, Sunderland. From 1935 to 1940, he was employed in the Operation Department of the North Eastern Electric Company, Newcastle-upon-Tyne. In 1940, he joined the City of Birmingham Gas Department and is now Electrical and Mechanical Engineer to the West Midlands Gas Board. As an external student, he has obtained the B.Sc.(Eng.) and M.Sc.(Eng.) degrees of London University, and in 1947 was awarded the Gold Medal of The Institution of Gas Engineers. He is a member of the Institution's Gas Works Safety Rules Committee.

RADIO COMMUNICATIONS IN THE FUEL AND POWER INDUSTRIES

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I SUMMARY

This is essentially a "review" paper, which attempts to generalize on the events leading up to the present state of radio communication practice of the Gas, electricity and coal industries in the United Kingdom: similar papers are being presented to the electrical and coal industries by other authors.

Both mobile and "fixed-to-fixed" applications are dealt with, particularly with reference to the work of the Radio Committee of the Fuel and Power Industries.

Comparison is made with the state of development abroad, and anticipated developments in the United Kingdom are detailed.

II INTRODUCTION

(A) HISTORICAL SURVEY

Prior to 1955, the Gas, electricity and coal industries were utilizing mobile radio equipment for consumer, operational control and rescue services. The degree of exploitation was severely restricted by the lack of frequency allocations from the General Post Office. Indeed, at this time the three industries only had the exclusive use of 11 two-frequency channels, the Gas Industry's share of this allocation being a single channel! The security of tenure of these channels was even more unsatisfactory, the G.P.O. being delightfully vague on this issue, always persisting with its protective clause to the effect that the allocation could be changed at its discretion, and, of course, allocations have been changed from time to time. The Gas Industry's application was restricted to consumer service, and consequently the Industry was loath to invest in such a dubious proposition; on the other hand, the electricity industry was using mobile radio for both system control and consumer service, and, therefore, the service was more highly developed. The National Coal Board's application was limited to ambulance and rescue services.

At this time, frequency allocations were being made by the G.P.O. on a relatively broad channel width of 100 kc/s in two bands: the low band, approximately 80 mc/s, was most popular with manufacturers and users alike, both of whom claimed superior performance when compared with similar equipment in the high band, approximately 180 mc/s.

In 1955, the Postmaster-General's Mobile Radio Committee proposed that the three industries should share their individual channel allocations, which, in consequence, could

be reduced in total from 11 to seven. In an endeavour to combat these proposals, the fuel and power industries themselves established a Radio Committee under the ægis of the electricity supply industry, since termed the Radio Committee of the Fuel and Power Industries: a Technical Panel was also appointed, its terms of reference being simply to produce a counter-report to that of the Postmaster-General's Mobile Radio Committee, requesting a substantial increase in the existing allocations and that such allocations be on an exclusive basis to each industry. A request was also to be made for complete security of tenure. In due course, the Technical Panel produced such a report, which was presented by each industry to the Minister of Fuel and Power for onward transmission to the Postmaster-General, and which ultimately resulted in a total allocation of 22 exclusive channels, plus several general-purpose channels on a shared basis. Furthermore, fuel and power industries representation on the Postmaster General's Mobile Radio Committee was obtained.

(B) Frequency Plans

In reviewing the position, the Technical Panel recommended that the new 50 kc/s spacing proposed by the Postmaster-General's Mobile Radio Committee for the low band should be to the higher order of 25 kc/s and applied also to the high band. It might be mentioned that at this time there was little suitable equipment on the market and there was no G.P.O. specification for such equipment available; nevertheless, both manufacturers and the G.P.O. co-operated readily in this experiment, and the result is now well known and historic.

The Gas Industry's share of this group allocation was six exclusive channels, two in the low band and four in the high band, together with such general purpose channels as may be required for special duties in specific areas, and to date numbering three. All channels have 25 kc/s separation and their details are as follows:—

Low Band	High Band
No. 1—85·275/71·775	No. 2—165·25/170·05
No. 3—85·25/71·75	No. 4.—165·275/170·075
	No. 5—165·325/170·125
	No. 6—165·3/170·100

The ratification of these proposals was conditional upon the production, by the fuel and power industries, of a comprehensive allocation plan for the United Kingdom in which the requirements of each industry should be clearly stated, the geographical location of each allocation being chosen so as to give freedom from interference between the various Area Boards. In the case of the electricity industry, control functions required that communications should be made over a wide area embracing the whole territory, up to the boundary of each Area Board; consequently, an 80-mile spacing between stations was necessary to prevent interference. This criterion leads to a very approximate allocation solution of six frequencies per Area Electricity Board. The Gas Industry's requirement was mainly restricted to urban areas, and, accordingly, a 40-mile criterion was proposed, which gave each Area Board the full use of all the six frequencies allocated to the Gas Industry the location of each frequency, however, presented a more difficult problem, relative to the electricity industry's criterion, in order to obtain interference-free working between Area Gas Boards in densely populated districts. Consequently, the allocations to the Gas Industry, whilst being more flexible, are more critical, particularly on adjacent territories of different Area Boards.

The Technical Panel was responsible for drawing up the proposed plans, which were finally agreed with the G.P.O. The allocation as originally proposed has been adhered to in principle, it is shown in Figure 1, but there are noticeable differences to the original plan in operation today and which have been negotiated, for specific reasons of organization, with advantage to the Area Boards concerned; the plan is therefore flexible to some extent. The National Coal Board's allocations have been restricted to mines rescue and ambulance services on two channels.

The electricity and coal industries' allocations are as follows:—

User	*Number of Channels*
Area Electricity Boards	4 low band, 4 high band (exclusive). 3 general purpose.
Central Electricity Generating Board	1 low band, *single*-frequency (exclusive). 1 „ „ „ „ (to be shared with U.K.A.E.A.* if possible). 1 maritime band.
National Coal Board	1 low band (exclusive—mines rescue). 1 general purpose, low band (to be used by N.C.B. ambulance service.)

In these cases, all the allocations have been taken up, giving 100 per cent mobile radio coverage, and most equipments have been changed to the new 25 kc/s specification.

In the case of the Gas Industry, about 70 per cent of the allocations have either been taken up or planned for use in the near future, but little existing equipment has been converted to the new 25 kc/s specification. It is imperative that the Gas Industry should make full use of its frequency allocations, otherwise there will be a danger of the G.P.O. requesting a reversion of the unused frequencies to general purpose allocations outside the scope of the fuel and power industries.

In addition to the mobile channels, the report of the Radio Committee of the Fuel and Power Industries requested frequency allocations for fixed-to-fixed operation, both in connexion with mobile and telemetering schemes. This request has been duly acknowledged by the G.P.O. and allocation plans for the three industries are now in course of being laid before them for approval. As an interim measure, the G.P.O. has conceded a provisional allocation of six frequencies in the 460 mc/s band for this duty, and already two Area Gas Boards have taken up two of these channels.

(C) Foreign Study of "Fixed-to-Fixed" Facilities

Unfortunately, experience of telemetering and telecontrol by radio methods has been severely limited in the United Kingdom due to no other cause than a complete restriction on fixed-to-fixed operation of radio stations by the G.P.O., except in the marginal cases where lines were unavailable, although it is to be observed that the G.P.O. itself has been very ready to use this form of communication link in support of its own line system. Foreign experience had, therefore, to be sought, and accordingly the Technical Panel made a comprehensive tour of the North American Continent, where the application was found to be in general use and where experience had proved the radio link to be a most reliable and economic communication link. In addition, radio methods had been applied to coding and decoding techniques, which, together with advanced multiplexing methods, had resulted in an information rate of the order of 3,000 to 4,000 bits/second being obtained with standard Tarriff "D" circuits, the emphasis being on fast

* United Kingdom Atomic Energy Authority.

FIGURE 1.—*Map showing Allocation to Area Gas Boards of Radio Communication Frequencies (based on 40-mile spacing)*

data processing for " on "- and " off "-line computer operation. The Technical Panel had already prepared suitable specifications for this type of equipment prior to the visit, and, subsequently, demonstrated British pilot equipment to selected personnel from the three fuel and power industries.

III MOBILE FACILITIES

The mobile facility aims at providing a two-way telephone communication system of infinite flexibility and extreme reliability, which can be utilized for the very exacting duties of the three industries, such as system control, consumer service and rescue work, consistent with the economies of both labour and transport. Clearly, the normal G.P.O. public telephone service cannot cope with such a highly saturated mobile service, and, consequently, offers no solution whatsoever to the problem; lines can be used for mobile tie lines as detailed later.

The electricity industry is a rapidly growing industry, and the mobile radio-telephone facility has enabled it to give improved service and to cope with increased plant and services without an increase in its labour force. In both the Gas and coal industries, it has largely been a story of increased operating and service efficiencies enabling a better service to be offered to the public at less cost. Despite the obvious operational advantages offered by a radio-telephone service, it is seldom possible to show any great financial saving; nevertheless, the result, after it has been installed, is always the same: " However did we manage without it? "

Generally, it has been observed that mobile radio-telephone systems are treated as adjuncts to an existing organization, and in such cases the facility is seldom applied with optimum advantage: the mobile facility is indeed a function within its own right, which must be treated as a basic facility around which a suitable organization can be developed; only in this way can the economic and operational advantages be fully realized. An example can be quoted from the Birmingham Division of the West Midlands Gas Board, where a number of mobile units had been in operation with a consumer service organization for several years; they were, in fact, added to an existing service without any fundamental change in operational procedure and simply provided a number of vans and service personnel on immediate call. Recently, the whole consumer servicing procedure has been reorganized on the basis of one mobile unit per service man *via* a central control depot having inner and outer servicing rings; results have shown a saving of £7,000/annum, at the same time

FIGURE 2.—*Radio-controlled Service Vans of The West Midlands Gas Board's Birmingham Division Sales and Service Department*

providing a superior and somewhat spectacular service. (Figures 2 and 3.)

(A) Area of Coverage

The major problem with the mobile facility is the provision of adequate "coverage" with a minimum number of blind spots: this problem is more serious to the electric supply industry where it requires continuous communication to the boundaries of each Area Board. The ready answer is increased transmitting power, but this brings so many side problems in its wake, particularly with respect to interference, that the G.P.O. has restricted the maximum effective radiated power to 25 W, and, indeed, this has been proved to be a very equitable figure. Nevertheless, it has not proved completely adequate for the electricity industry and it has been necessary to utilize several transmitters operating on multiple channels. Transmission difficulties have been experienced with multiple operation, but these have now been overcome. The principle involved is simply the staggering of each station slightly "off tune" by a few kc/s; the beat signals experienced are then within the audio range and are capable of being filtered out; mobile equipment must be "flat tuned" over the stagger or off-tune range.

Emphasis has already been laid on the coverage area of a particular transmitter in relation to signal strength. Siting of the aerial is equally vital, and elevations of the order of 250 ft above the extreme reception areas are required, which generally give a coverage of approximately 20 miles. Shorter distances, and longer, are quite common and generalizations cannot be made with any degree of confidence; reliable results can only be guaranteed by comprehensive site surveys which are best carried out by the manufacturers, care being taken to employ only normal equipment during these tests. Favourable sites are generally found to be situated some distance from the operational centre, consequently it is necessary to operate them remotely; this involves a form of "talk-through" facility that is best achieved by direct wire or fixed-to-fixed radio link. In this case, the remotely situated transmitter can be automatically monitored and return alarms provided for irregular operation. In the Gas Industry, it has been usual to install 25 W fixed station equipment on the highest available site and to attenuate its output to the requisite value as proved by field trials, so as not to cause undue interference to neighbouring Boards. On mobile units, the maximum available power is somewhat less, of the order of 15 W, and here the restriction is brought about by battery and car, or van, generator capacity.

FIGURE 3.—*The Radio Control Centre of The West Midlands Gas Board's Birmingham Division Sales and Service Department*

Generally, blind spots are experienced, but operators have been found to acquaint themselves with these spots, which are usually very local except in particularly bad terrain. It is mainly for this reason that frequency modulated equipment has never proved popular since the signal strength of such equipment very rapidly attenuates, with distance, once a given minimum threshold has been reached. Thus, with amplitude modulated equipment, now used almost exclusively by the fuel and power industries, signal strength falls off slowly and the direction of increasing strength can be very readily observed by an operator: frequency modulated systems give no such assistance, the signal is either strong or absent altogether.

In every case, blind spots have to be tolerated to some extent and the best solution is to teach operators to live with them.

(B) Type of Service

Two-way telephony can be established either on a "simplex" or "duplex" basis, using either one or two frequencies in the first case and two frequencies in the second case.

With a simplex service, a single frequency can be used which enables operators to talk together two or more at any given time; this allows mobiles to converse freely with each other as well as with the central transmitting station. For some obscure reason, and in spite of the obvious flexibility of this system, it is not popular: it has been stated as being uneconomical in the use of frequencies, but this is doubtful, and where it is being operated by the Central Electricity Generating Board it has proved to be both flexible and efficient. Clearly, a single frequency restricts either transmission or reception to one direction at a time—this is the definition of simplex operation—and the main advantage of this method is its ability to maintain operational silence of the receiving station. Two frequencies also allow simplex working, but without intercommunication with other mobiles; some form of retransmission from the base station is necessary if this intercommunication feature is to be retained, and the result is a talk-through system. Such talk-through services can be readily obtained and arranged either for automatic or manual operation: the former method leads to spurious triggering of the main transmiter by interference signals, which has been experienced particularly when the main fixed station is controlled remotely. However, with the firm and exclusive frequency allocations now made to the fuel and power industries, this trouble has undoubtedly been over-emphasized; nevertheless, the G.P.O. is loath to allow talk-through except on manual control and generally only for inter-mobile working. For remote control duty, land lines or fixed-to-fixed radio methods are to be preferred. Talk-through facilities can also be obtained by operating mobiles on reverse frequencies, but this requires duplication of mobile transmitters and receivers and is expensive. Multi-channel equipment is also available which gives a selection of preset channels and enables equipment to be interchanged in different areas where there are different frequency allocations.

Full duplex working is essential if the mobile system is to be integrated into the normal telephone system. Such equipment requires the use of two frequencies which must be arranged so as to give simultaneous transmission and reception in both directions. This method has not been favoured, but is allowed by the G.P.O. There are both technical and operational disadvantages associated with this type of service and, consequently, it has never become popular.

(C) Mobile Frequency Allocations

All the frequency allocations for mobile work have been made by the technical panel of the Radio Committee of the Fuel and Power Industries, and, before the channels could be obtained from the G.P.O., it was necessary to prepare a comprehensive plan for each industry. This was rather a laborious process, particularly for the Gas Industry where development of the mobile facility was very much in the planning stage with most Area Boards and where a 40-mile spacing criterion had been adopted. Changes of Area Board plans have been experienced and, accordingly, the original plan has had to be modified, each modification being separately ratified with the G.P.O. Originally, the plan was prepared with the aid of a light source and relief model so as to determine the degree of "spill-over" of the signals from one area to another; shafts of light indicate spill-over, which, in practice," would lead to interference. A typical photograph is shown in Figure 4. The high-lights indicate the high degree of scatter to be expected from the given transmitter location. Blind spots are also clearly shown. By raising the light source or increasing its intensity, a greater transmission range can be assimilated. This analysis is qualitative, but it does indicate the likely trouble spots. The equipment and contour models were specially made by The Central Electricity Research Department for this type of exercise: the work was tedious and very time-consuming, but the interference-free results now being experienced by the three industries is adequate proof of the efficacy of this method.

To justify the Committee's request for 22 exclusive channels, it was necessary to prove to the G.P.O. that a high message-loading time would be achieved with this allocation, and, accordingly, a very comprehensive survey of existing usage by all three industries was carried out in the area between the Wash and the Mersey. Area Boards co-operated in this procedure most readily, whence it was found that many of the existing channels were completely saturated. This was particularly in evidence in the electricity supply industry during thunderstorms. The G.P.O., at this stage, lacked a real appreciation of the problem and it was necessary to demonstrate the operational procedure of the industries to senior officers of the G.P.O. before final approval was given. The main argument presented by the G.P.O. against the requested allocation was concerned with the number of mobiles operating from a given fixed station and was supported by examples of installations from various taxi services in London: this gives some idea of the relative importance with which the G.P.O. viewed the fuel and power industries' application. Nevertheless, it is to be observed that, in the United States of America, a saturation figure of 100 mobiles per fixed station is used as a secondary criterion of channel allocation for the petroleum and fuel and power industries, as compared with about 20 in the United Kingdom, and there is little doubt that the present operational procedure on the air, of the United Kingdom fuel and power industries, is far too verbose. Particularly is this so with consumer service, as distinct from operational service in connexion with plant or system operation; in this respect, it has been suggested that call signs should be restricted to a two-digit number, as used abroad, and with the semi-exclusive channels as now used by the fuel and power industries this system is practical and, moreover, acceptable to the G.P.O.

(D) Developments in Mobile Equipment

On the technical side, the most important development has been concerned with channel-width-splitting from 100

to 25 kc/s. This feature, which was introduced by the Technical Panel of the Radio Committee of the Fuel and Power Industries well in advance of normal G.P.O. specifications, bids fair to being the greatest single step forward since mobile radio was originally introduced. There is no doubt that, with universal adoption of 25 kc/s channel spacing, problems associated with available radio spectra will be solved for many years to come.

One development that the Committee would particularly welcome is the transistorizing of mobile equipment; this would enable the "pack set" to have a greater range and thus be available for use inside premises where consumer and operational service men may be working and, therefore, out of contact with the service van. Such equipment is already available abroad. It is generally used as a personal set and carried on a waist belt by such personnel as police, traffic patrols and electricity linesmen: this equipment, of foreign origin, is expected to be introduced into the United Kingdom at any time now.

Selective calling of individual mobiles, other than by multiple-channel equipment, is a very desirable feature that has not yet been applied to fuel and power industries equipments: it is not available in the United Kingdom other than in a complex form. Simple devices are, however, available in other countries. This equipment would enable individual mobiles to be called and would be a very valuable addition to the standard sets.

The use of the high band, approximately 180 mc/s, for mobile work is another development that the Technical Panel has fostered. It was assumed by most manufacturers and users that transmission in this band was inferior to that in the low band. The Panel has carried out extensive tests in this band, and results have been equal, in every practical respect, with low-band performance: this is confirmed in practice by the many sets that are now in satisfactory operation throughout the various Area Boards. Nevertheless, it is an accepted fact that, as the frequency of a radio signal increases, its directional properties predominate so that the scatter effect, which is assisted by buildings, is reduced and the incidence of blind spots enhanced. What is the practical upper limit? is a natural query and this can best be answered by the experience of the North American operators, who use 450 mc/s for mobile work almost exclusively! With this figure in mind, doubts as regards channel availability for future mobile development and expansion can be immediately dispelled.

The mobile facility is well known, although it must be admitted that it is far from being fully exploited in the

FIGURE 4.—*Typical Photograph of Relief Map showing Use of a Light Source for Optical Propagation in connexion with Planned Radio Control*

United Kingdom; to a great exent, its future development depends upon more flexible designs by the manufacturers and upon miniaturization using solid-state devices.

IV FIXED FACILITIES

The fixed-to-fixed facility in the United Kingdom is as yet untried and opens an exciting new field of development to every applications engineer. This facility offers a most flexible, reliable and economic transmission link system for the most exacting of communication functions. It may be mentioned that each member of the fuel and power industries group is planning some elementary applications of this technique. This position contrasts very vividly with the many applications that are already in operational use in similar industries in almost every country other than the United Kingdom, particularly in the United States of America, where approximately 50 per cent of all vital communication functions employ this facility.

In dealing with the fixed facility, it is not proposed to enter into a discussion on telecommunication theory, since the Author has quite recently presented a paper dealing with this aspect to the Northern Section of The Institution of Gas Engineers. Nevertheless, it is perhaps necessary to define the term "telecommunications" in the general sense as the transmission of intelligence in the form of an electric signal, which may be used for such functions as telemetering and telecontrol as well as for speech, for which function it is well known. As previously mentioned, both telemetering and telecontrol by the radiative mode are not practiced in this country, consequently it is necessary to consider foreign applications. In this respect, it is to be noted that the Technical Panel has studied foreign practice both in the United States of America and on the Continent of Europe in great detail. To emphasize the great gap between United Kingdom and North American practice in this field, the following specifications may be quoted for a typical G.P.O. "D"-type link:—

(1) "... speeds of several hundred bits/second should be possible.

(2) "... maximum information capacity 3,000 bits/second."

The first specification is taken from the latest publication of the G.P.O., "Facilities for Data Transmission", the second relates to the Collins Kineplex equipment, which has been available for several years: even higher speeds, of the order of 4,000 bits/second, are now being offered in the United States of America for computer work. The seriousness of this position lies in the fact that, in the United Kingdom, radio frequency allocations, with inherently higher bandwidths and, therefore, higher information capacities, have been dependent upon the non-availability of G.P.O. lines

In the United Kingdom, present practice is almost exclusively confined to G.P.O. private wires; relatively few privately owned wires are used. Unfortunately, G.P.O. installations have never been designed for the important duties associated with the telemetering and telecontrol functions of vital plant, particularly with regard to reliability and maintenance. Duplication of G.P.O. lines is invariably found to be essential in order to obtain reasonable continuity of service, but experience has proved the inadequacy of duplication alone in such circumstances as are associated with lightning and heavy rain storms, which invariably delay repairs by many days. Again, there is the question of costs, which, for a duplicate "D" line, are of the order of £24/mile. Such a rental has a break-even distance of about two miles when compared with a standard 450 mc/s radio link, excluding antennae, whilst at the same time the radio link provides a much higher information capacity. If the comparison is made with a sophisticated microwave link, the break-even distance is about six miles on the basis of American costs.

(A) Information Capacity of a System

When making such comparisons, it is essential to bear in mind that the basis of comparison is always related to the information capacity of the transmission link according to the approximate formula

$$L = 2W.\ \log(1 + \frac{S}{N})$$

where L = information capacity,
W = available bandwidth of the link system,
S = signal strength,
N = noise strength.

In the binary code system the formula is $L = 2W \log_2 (1 + \frac{S}{N})$ whence L gives the number of bits/second transmitted. Generally, this formula is approximated to $L = 2W$ since W is the most significant parameter, but it should be appreciated that N is a function of the square root of W, and therefore, there is a limiting value of W above which little improvement is made in L: i.e., when $S/N < 1$.

The foregoing relationship has been mentioned because it brings out the important parameter of bandwidth, and the significance of working in the higher frequency ranges, where greater bandwidths are available, becomes readily apparent. Thus in the V.H.F. bands, with 25 kc/s separation and guard bands of 5 kc/s, $L \simeq$ 30,000 bits/second, whereas in the microwave bands a 2-mc/s bandwidth is available and $L \simeq 4 \times 10^6$ bits/second. These information rates would appear to be excessively high for normal telemeter and telecontrol duties; they are, however, of the right order for fast on-line computer techniques. Such an application is now projected by the National Coal Board in connexion with the IBM 75 computer installation in the Midlands. The Technical Panel is preparing to approach the G.P.O. for suitable frequency allocations for this application, which will enable the various districts to be tied to divisional headquarters by fixed radio links. If such data processing duties are to be imposed on a radio link, there is no practical alternative to a digital form of intelligence; analogue forms must be converted to this digital form, and suitable digital/analogue conversion equipment must be provided when process functions such as temperatures, pressures, voltages and currents are involved, i.e., for the telemeter or telecontrol application.

The information rate of transmission of these functions is related to the rate at which they are changing, since some form of sampling procedure must be adopted. Generally, the sampling is carried out according to a convergent Fourier series, the sampling rate being of the order of $2{\cdot}5f(\text{max})$, where $f(\text{max})$ is the highest Fourier component of the series. Each sample is in reality a square wave pulse whose frequency spectrum is compared with the frequency spectrum of the intelligence presented for transmission, hence the term "pulse coding"; it is this sample that is termed a "bit" of information, or, more technically, a "baud". With slowly varying data, bandwidths of a few

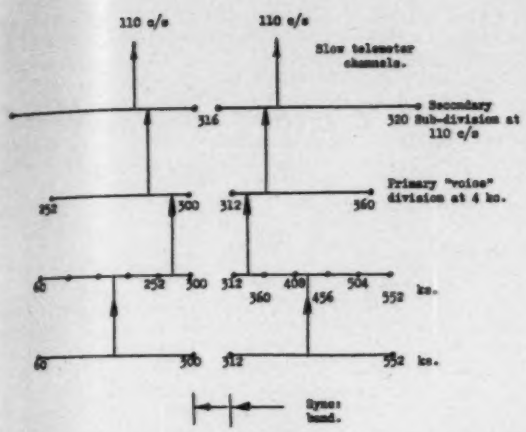

FIGURE 5.—*Typical Frequency Division Multiplexing Scheme*

tens of cycles are sufficient to give the required accuracy; in this case, the wide bandwidths of the radio link can be multiplexed, firstly, into convenient " voice " bands of about 4,000 c/s and, secondly, into " tone " bands of approximately 120 c/s, each of which carries one set of data or intelligence. This form of multiplexing is termed frequency division and a typical arrangement is shown in Figure 5. The second method is termed " time division multiplexing " and involves periodic sampling at the sending end together with synchronized reconstruction of the samples at the receiving end. When these two forms of multiplexing are used together, a very high information capacity can be obtained, limited only by the repetition rate required and the rate of change of the intelligence.

The accuracy that may be achieved by a digital system depends upon the number of digits designed into the analogue/digital convertor. The information capacity of the system, for a given time dependency, is related to accuracy in so far as a given number of bits are required for each character of the intelligence, a greater number being required for each character as the number of digits and, therefore, the accuracy are increased.

(B) FOREIGN PRACTICE

The fuel and power industries' specification (see Section IV(c)) is an attempt to give the industries a standardized telemeter and telecontrol system based on modern radio techniques and capable of being integrated into an all-embracing radio or line communications scheme. This is typical of the most advanced foreign practice in this field where mobile units, fixed-to-fixed telecontrol and telemeter schemes, by radio and wire, and speech circuits are tied together into one communication system by means of a microwave trunk line. Undoubtedly, the country most advanced in this technique is the United States of America. Canada also has some very fine installations. A comprehensive report on the equipments in use and the basis of frequency allocations in these two countries has been made by the Technical Panel, and has had a very wide circulation—judged by the fact that the third reprint is now being made—and has been received by both users and manufacturers both in the United Kingdom and in America. Accordingly, it is only proposed to generalize on this particular aspect.

The great advance made by the public utilities in the United States of America in the field of applied radio techniques has been explained away in the United Kingdom by statements that their large concentrations of power and system areas favoured the use of these techniques. The various undertakings employing fixed-to-fixed radio are, in fact, so diverse in both size and capacity that these criteria are just not valid; there are, of course, isolated cases where physical criteria are involved, such as pipelines several hundred miles long and passing through terrain where continuity of wired systems would be impossible: these cases are in the extreme minority. The valid reason is simply that, as and when a shortage of wire circuits was experienced, alternative techniques were investigated; other methods, such as power line carrier, sometimes termed guided radio, have also been tried, but the radio method has ultimately prevailed, seemingly on all counts.

With regard to the integration of equipment, fixed-to-fixed radio links are used quite extensively so as to link up many mobile applications situated many hundreds of miles apart. It is quite common to find a single fixed radio link operating with multiple-frequency division channels and combining consumer, operational, repair and constructional services with accountancy functions, administrative service, payroll security and general transport. As a general statement it might be said that most, if not all, services that involve transport, both passenger and commercial, operate mobile radio systems over some form of fixed link, usually radio.

The telemeter and telecontrol functions relative to the mobile function are less well established in the United States of America, since there is not more than 10 years' operating experience in this field; nevertheless, during this short space of time, fixed-link systems have been developed and installed in the 1,000, 2,000 and 6,000 mc/s bands to such an extent that they provide the major proportion of available services and are now being installed almost exclusively. The highest order of reliability is required in electrical protection practice, that is, protective relaying on cable and overhead lines; the American systems have an operational reliability index figure of the order of 99·98 per cent,* and the equipment has proved to be so reliable that some utilities are reserving all available " radio space " for this highly specialized function. Generally, it may be stated that fixed-to-fixed radio links are replacing all other forms of communication system links in the United States of America, and that the flexibility inherent in this form of link is enabling many automatic control functions to be developed. Electrical power systems in the United States of America are not so highly integrated as in the United Kingdom. There is no national grid system, but most networks are interconnected to an extent that allows economic transfer of power between adjacent undertakings. Such energy transfer is optimized by special-purpose computers which either automatically control the various generating stations or provide supervisory information to the control personnel who perform the adjustments manually. Radio links are invariably used for this duty. A similar procedure is adopted in the case of the transmission of gas. In addition, meter readings of large gas users are monitored by radio at peak-load times, which enables load shedding to be carried out for economic considerations.

Both transmitting and receiving apparatus in " building brick " basic units, have been developed specifically for unattended operation and may be installed in locations not readily accessible during severe weather. Weather-proof housings, towers and emergency power equipment are also of standard types, all of which are easy to install and maintain.

* This figure represents an outage of ½ hr/annum.

Because of the nature of the information transmitted, the microwave system must be operated continuously and requires 100 per cent standby equipment. There are three methods of providing radio standby namely, (*a*) cold, (*b*) semi-cold, and (*c*) hot: all can be automatically brought into service by failure-sensing devices, which also cause an appropriate alarm to be transmitted. Fading must be kept to a minimum, and this can be achieved by the continuous operation of two equipments on a frequency or space-diversity basis.

The 1,000 mc/s systems have been specifically designed to be as simple as possible with a base band accommodating no more than about five voice channels, or the equivalent signalling channels, and to be operative over distances of approximately 25 miles with maximum transmission distances of 100 miles when using three repeater stations. At these frequencies, conventional triodes may be employed without a regulated power supply, and the amplifier stages can be most economical. Antenna beam width is fairly broad and this enables an inexpensive tower to be employed, however, natural antenna gain is limited and passive reflectors cannot be used. Such types of equipment are reputed to be less than one-third the cost of equivalent conventional wire lines.

Equipment in the 2,000 mc/s range is substantially the same as that in the 1,000 mc/s range, but the higher radio frequency beam is narrower, thus giving higher gain with an antenna of smaller dimensions. In consequence, the equipment has greater range and is recommended for single hops of approximately 40 miles.

In the 6,000 mc/s range, the use of reflex klystrons is essential, but their reliability never appears to be in doubt, a life of 20,000 hr being freely quoted. This range offers a potentially greater base bandwidth and, therefore, greater channelling and information capacity. Thus, with single side-band suppressed carrier, standard equipments can cater for up to about 250 voice channels or the equivalent signalling channels. Operationally, there is improved signal-to-noise ratio, improved antenna gain characteristics and low wave-guide loss which enables the equipment to be run ultra-conservatively; smaller ground clearances are also required, which result in more economic tower construction. This type of equipment is used for hops of up to 60 miles and is now the most popular system with the American utilities.

The type of microwave system now being employed by the American utilities comprises the pattern of a basic microwave backbone, which follows the most densely supplied areas, supported by spurs feeding into numerous points along the system.

Such microwave systems require a line-of-sight communication path. Extensive systems are operated, which extend for 1,000 miles or more *via* repeater stations at intervals in the range 25 to 60 miles, dependent upon the terrain and the frequency of the system. In certain cases, passive reflectors can be used to advantage. The repeater stations receive and transmit the radio beam signals in both directions along the communication route. The directivity of the radio beam ensures absolute privacy so that all district offices and operating points are tied together to give continuous two-way communication and transmission of all forms of data and control signals.

An appraisal of the radio method and even successful pilot schemes are not alone capable of producing the results achieved in the United States of America. Adequate operating radio channels are a necessity and must have been provided in sufficient quantity. In this respect, the Federal Communications Commission, the frequency allocation committee of America, have assisted the industries in every possible way both technically and with adequate frequency allocations. The F.C.C. is a body set up by the Government of the United States of America to further the usage of radio, as well as allocating frequencies; consequently, any such allocation is free from any conditional wire-line availability. This position is to be contrasted with that in the United Kingdom, where the G.P.O., prior to the approach of the Radio Committee of the Fuel and Power Industries, refused to consider any application of a fixed-to-fixed radio link. There is little wonder that British manufacturers have done little or nothing in this market. In the United States of America this branch of electronics is a thriving industry.

(c) Standard Specification for Fixed Facilities

The potential market for radio communication links and electronic telemetering and telecontrol equipment is very large indeed, embracing many other industries besides those of the fuel and power group, but can these industries present the case for frequency allocations as the fuel and power industries have done? Have they, indeed, a case for fixed-to-fixed operation by radio? The answer is doubtful, but there is no reason whatsoever why these industries should not use G.P.O. land lines both inside and between plants, provided the intelligence or data processing equipments are designed for use with, say, a "D"-tariff circuit of the G.P.O. Only in this manner can the potential market be fully realized and enable standard equipments to be produced at very competitive prices. Accordingly, the Technical Panel has produced a general operational specification for suitable telemetering and telecontrol equipment, which can be used over wire or radio links and will enable the manufacturers to standardize on basic design parameters. Two manufacturers have already demonstrated pilot equipment to the fuel and power industries, and others have shown tremendous interest. A questionnaire has been circulated throughout the three industries so that final design details can be concluded. Although it might be expected that there would be extreme divergence of opinion, relative to such basic parameters as number of channels and number of functions per channel, the questionnaire revealed that a surprisingly high degree of unanimity existed. The finalized specification has now been prepared by the Technical Panel and is awaiting ratification by the main Radio Committee.

The success of this work will depend upon the various application engineers within the fuel and power group adhering to this standard specification. There is plenty of scope for individual requirements to be written into the specification, but any fundamental changes will be costly. Essentially, the specification has been based on economic considerations and preliminary prices quoted by the manufacturers indicate that costs of the order of one-half the cost of conventional equipment, as now used, can be confidently expected.

General details of the specification are contained in the Appendix to this paper.

(d) Fixed-to-Fixed Frequency Allocations

The Technical Panel is at present engaged on the preparation of frequency allocation plans for fixed-to-fixed facilities. Three types of facility are envisaged. They are:—

(1) Fixed radio links for the interconnexion of mobile systems.

(2) Fixed radio links for the telemeter and telecontrol functions.

(3) Fixed radio links comprising a trunk or backbone communication system into which all communication services can be integrated.

The requirements of mobile systems are fairly clearly defined and are expected to be met in the 450 mc/s band. Low-power directed interconnectors are envisaged which will replace all G.P.O. tie lines of lengths exceeding 5 miles. The criterion adopted for allocation is a fixed station-separation distance of 40 miles and a horizontal transmission deviation of some 20°, these conditions lead to the following requirements:

Gas Industry	.. ..	7 two-frequency channels,
Electricity Industry	..	14 two-frequency channels,
Coal Industry	.. ..	7 two-frequency channels,

for which application to the G.P.O. has already been made.

The telemeter and telecontrol requirements at this stage are purely conjecture; whilst very great interest in this service has already been shown, the ultimate picture is far from clear. In spite of this position, the G.P.O. is insistent on the preparation of a comprehensive allocation plan. Accordingly, the Technical Panel, using similar criteria to that of the mobile systems and assuming the same 450 mc/s band together with a coverage per fixed station of the order of 1,000 sq miles, is endeavouring to meet this request. The G.P.O. is apprised of this position and is readily co-operating with the Technical Panel by making interim allocations on an experimental basis. These allocations cannot be considered firm and may have to be changed in the final plan; the changes, however, will only involve re-crystallization and will not be concerned with any change in bandwidth, they are therefore, quite insignificant. The following requirements have been made known to the G.P.O.:

Gas Industry	.. ..	4 two-frequency channels.
Electricity Industry	..	8 two-frequency channels.

The third function is essentially the province of a microwave system. The Technical Panel, on completion of the allocation plans for the 450 mc/s band, is charged with the study of such a system as could provide a trunk communication link throughout the length and breadth of the country for the use, on a shared basis, of the fuel and power industries. This service would be expected to provide the final link in a comprehensive communication scheme. An experimental system in the 7,000 mc/s microwave band is already under construction for the Central Electricity Research Department. It is designed to operate over a distance of about 16 miles, or more. This facility is most comprehensive and includes automatic duplicate operation together with telephonic communications, telemetering, telecontrol and protective relaying features.

To prepare such a series of allocation plans for the three industries, and covering the whole country, would be an almost impossible task; accordingly, the Midlands belt of the country was again selected for analysis by the Technical Panel.

V CONCLUSIONS

Foreign practice in the field of radio communication emphasizes very clearly that the experimental stage of the techniques involved in the most complex systems has long since passed, so that installations for the most important applications can be made with every confidence. It is essential that application engineers associated with the fuel and power industries shall fully appreciate the possible applications of radio techniques. In this respect, emphasis must be placed on the high degree of reliability that a radio system can offer over conventional line systems, particularly when transistorized equipment is used, and also on the economies to be effected. Furthermore, the flexibility of radio systems contrasts very markedly with the rigidity of line systems, particularly as regards ready availability.

There is little doubt that the policy of the American Federal Communications Commission in publishing, quite freely, its allocation plans has given great confidence to both users and manufacturers of this type of equipment. The relaxation now afforded by the G.P.O. in the case of fixed-to-fixed working for the fuel and power industries can be expected to give the same impetus in the United Kingdom; indeed, a number of manufacturers have already shown great interest and produced pilot equipment.

In dealing with a common service to three such major industries as form the fuel and power group in the United Kingdom, there is an excellent opportunity to assist both the manufacturers and the industries concerned by accepting a standardized product as outlined in the general specification. (See Appendix.) A very strong plea is made to all potential users in this respect: costs can only be kept down by adopting this procedure.

The introduction of this type of equipment in the British fuel and power Industries is now urgently required for the integration of both operational and administrative functions, but a word of warning must be sounded relative to future developments. The general specification already produced is in line with modern ideas abroad, but techniques in this particular industry are changing with extreme rapidity, probably due to the missile application. It is therefore essential that sufficient flexibility be written into any proposed scheme to enable future requirements to be dealt with so that the system does not, at least, become prematurely saturated.

Acknowledgment

The Author wishes to thank Mr. G. le B. Diamond, C.B.E., the Chairman of the West Midlands Gas Board, for permission to present this paper and for his continued support in the field of applied electronics.

APPENDIX

DRAFT SPECIFICATION FOR ELECTRONIC TELECONTROL EQUIPMENT

1. GENERAL REQUIREMENTS

1.1 *Scope of System*

This Specification defines the requirements of a remote information transmission system operated through the medium of radio links, power line carrier or physical circuits having characteristics not less than those for G.P.O. Tariff-D circuits.

The equipment is intended to meet the following basic requirements of the three fuel and power industries

(*a*) To provide information at a central control point

regarding the state of plant at a number of out-stations which are normally unattended. The information relates to the fundamental energy measurements concerned with the mass flow of prime energy quantities and the physical state of power and process plant. The transmission of information in the inwards direction, i.e., from the out-stations to the control point, shall be effected by sequential scanning or on demand of the control station, or by the combination of both these methods. In no case shall the scanning time of a complete out-station exceed 1 min. The indication of alarm functions at the out-stations, is required to be self-initiating and immediately transmitted to the control station.

(*b*) To provide facilities for the remote control of selected items of plant situated at the out-stations.

(*c*) To display the information at the control station in accordance with certain predetermined sequences which are detailed later.

1.2. *Size of System and Equipments*

The equipment shall be so designed and constructed that it is readily extensible *in situ* and interchangeable in part and whole, in units of convenient size, to cater for the following maximum quantities:—

1.2.1. Number of out-stations per system 100

1.2.2. Quantities per out-station:—

(*a*) On/off indications (2-state) 200

(*b*) Analogue functions 50

(*c*) On/off control functions (2-state) .. 100

2. Basic Design

2.1 *Basic Units*

The equipment shall consist of the following basic units:—

(*a*) Sensing elements.

(*b*) Coding unit.

(*c*) Transmitting unit.

(*d*) Receiving unit.

(*e*) Decoding unit.

(*f*) Display units.

Basically similar units shall be used for both directions of transmission. The equipment should preferably comprise items such as cold cathode tubes, transistors, magnetic cores, *etc.*, rather than electromagnetic relays and hot cathode valves.

2.2 *Sensing Elements*

The sensing element shall measure and convert into a common form, suitable for encoding, the prime functions of amperes, volts, watts, *etc.*, together with functions of mechanical displacement relating to:

(*a*) switch positions,

(*b*) transformer tap change switch positions,

(*c*) valve positions,

(*d*) float positions,

(*e*) gasholder height positions,

(*f*) pressures,

(*g*) temperatures,

(*h*) machine speeds,

(*i*) stock quantities, etc.

The sensing element shall obtain the information from existing current and voltage transformers and also from mechanical displacements which in some cases may be capable of direct translation into electrical quantities. The sensing element shall therefore be capable of accepting a.c., d.c., or mechanical sources of information. The sensing element shall be capable of providing, where required, pre-set limits for alarm purposes.

The mechanical arrangement of the sensing element shall consist of a shaft rotation which may be restricted to less than 360°. It must be capable of application to both sensitive and robust equipment, due regard being paid to the particular application. The accuracy of the sensing element should be in keeping with a displayed accuracy of ± 1 per cent, and the element should be so constructed as to give a high degree of reliability.

2.3 *Coding Unit*

The coding unit shall translate the output from the sensing element into a form suitable for transmission, e.g., binary form. The coding unit shall be capable of continuously monitoring the outputs from all the sensing units and be ready to initiate the transmission of any of the alarm signals.

The initiation of a transmission shall take place on receipt of the appropriate code signal from the control station, and this will initiate a sequence interrogation. The equipment shall be capable of automatically proceeding through a predetermined sequence of events and also interrogating one or more functions on demand. The coding equipment shall also be capable of initiating the transmission of alarm signals.

The coding equipment shall be self-monitoring and means shall be provided for routine tests to be initiated from the control point.

2.4 *Transmitting Unit*

The transmitting unit will normally comprise v.h.f. or u.h.f. fixed station radio equipment using 2-frequency operation in the 180 or 460 Mc/s band; the control station transmitter will operate on one of the frequencies and each out-station transmitter on the other frequency.

The out-station transmitting unit shall be capable of being modulated by the output of its associated coding unit in the form of tone impulse groups. The method of transmitting the information shall be by means of multiple audio tones used to modulate the radio frequency.

The out-station transmitting and coding units shall be arranged to be brought into operation remotely from the control station when a complete initiating code signal has been received by the associated radio receiving unit.

The bandwidth of the modulated signals shall be kept to a minimum, but shall be sufficient to give an accurate resolution of the signal codes at the remote receiver.

The control station radio frequency channel may also be required for speech communication with mobile stations; consideration should therefore be given to the combined use of mobile radio and telecontrol equipment on a common channel.

2.5 *Receiving Unit*

The receiving unit at any station will normally comprise a v.h.f. or u.h.f. fixed station radio equipment suitable for receiving signals from the remote transmitter.

When information is required from a given out-station, or when initiation of a control function is required, the control station shall send out a coded address to select the required out-station. Satisfactory completion of this operation shall cause the out-station to initiate a sequential scanning of the required information or to select the requisite control function. The out-station, after an identity check,

shall send back the requested information in the form of code groups which may include the identity of the out-station. The coded groups appearing at the output of the control station receiving unit shall be fed to the decoding unit.

2.6 *Decoding Unit.*

The decoding unit at the control station shall accept from the receiving unit coded signals corresponding to sequential information returns, control function selection confirmation and alarm signals initiated by the out-stations. These signals shall be decoded and immediately presented to the display units.

Facilities shall be provided for monitoring each code sequence as received and suitable audible and visible alarms of incorrect operation shall be provided.

2.7 *Display Units*

The annunciator panel shall be primarily designed for a common diagram system, but shall be capable of extension to an individual diagram system; in both cases, reception of an indication shall cause the station identity to be illuminated.

Quantitative information shall be presented by means of illuminated numeral counters corresponding to common functions. Two-state indications shall be displayed by means of indicating lamps.

A call for supervisory information shall be made by key-switch and, in the case of common diagram, the relevant parts of the diagram applicable to the outstation concerned shall be automatically illuminated coincident with this call; this display shall be maintained until manually cancelled. Provision shall be made for the selection of repetitive signals to be received at predetermined intervals over a period.

The control station equipment shall be capable of operating print-out equipment if required.

3. Alarms

The automatic transmission and receipt of alarm signals from out-stations is of paramount importance, and facilities shall be provided to ensure that all alarm signals are received without delay. Alarm signals are individual to the outstations, but the treatment of them should be such that alarm signals initiated simultaneously at a number of out-stations are transmitted sequentially without loss of any signal.

Alarms shall be given by audible and visual means.

When an alarm signal is received, it shall illuminate with a flashing signal the annunciator corresponding to the out-station affected. When the appropriate key-switch is operated, it shall cancel the audible alarm and request from the out-station an indication of the state of its various devices; the flashing signal shall be converted to a steady illumination.

All equipment associated with the transmission and reception of alarm signals shall be continuously energized. All on-line equipment shall be monitored and any failure shall cause an alarm to be transmitted; this shall include monitoring the power supplies to the telecontrol equipment.

4. Power Supplies

A non-stabilized a.c. mains supply of electricity will be provided at 200 to 250 V 50 c/s. for the operation of all equipment at the control station and all out-stations. All equipment shall continue to function for a period of not less than 6 hr in the event of loss of the mains supplies.

5. Construction of Equipment

The equipment should be designed for integration into existing and contemplated high quality 180 or 460 Mc/s radio link equipments. It should be constructed to the highest standards and arranged for 19 in. rack mounting in enclosed cubicles; the construction should be in accordance with Specifications such as R.CS.1000, K.114 or DEF.5000. Adequate provision shall be made for testing and maintenance by the use of plug-in sections, test points, built-in monitoring and testing equipment.

At the out-stations, the equipment may be mounted in unheated buildings, and in consequence it shall be suitably protected against the ingress of moisture and insects. In some cases, the sensing elements will be mounted in outdoor positions, and in consequence they shall be of watertight and dust-proof construction.

At the control station, the equipment will normally be housed in a well-ventilated and heated building and precautions comparable with those for the out-stations may be suitably relaxed.

PRESENTATION, DISCUSSION AND REPLY

Presentation

Mr. G. M. Rimmer presented his paper and summarized its contents.

Discussion

Mr. W. T. Hird (Cardiff) :—I am very delighted that Mr. Rimmer has been able to present his paper at this stage in the development of radio communications in the fuel and power industries.

Development in this field in Great Britain, has, up to now, been very slow. Mr. Rimmer points out in his paper that the General Post Office has in the past been extremely reluctant to allocate frequencies to industry, particularly for point-to-point communication, and that this has retarded development. I regard this as a triumph of understatement! However, I cannot help feeling that, had the demand of industry for radio communication been greater in the past, the pressure of demand would have resulted in an earlier relaxation of the restriction.

The aim of the Radio Committee of the Fuel and Power Industries, of which Mr. Rimmer is a very active member, has been to press the G.P.O. for a relaxation of the restrictions on the allocation of radio frequencies. The Committee has been successful in co-ordinating the radio requirements of the nationalised fuel and power industries in the field of mobile radio, and has obtained a greatly increased allocation of frequencies for these industries. The Committee is, at present, pressing for a similar block frequency allocation for fixed point-to-fixed point use, which would allow the development of radio telecommunication by the fuel industries.

As Mr. Rimmer has stated, it is important that each Area Gas Board should appreciate the uses that can be made of radio communication, and the operating and service efficiencies that can be achieved if full use is made of radio communication. I trust that this paper will promote a wide examination of its uses by the gas industry.

We must secure adequate radio frequency allocations today to meet our future development, for tomorrow those frequencies may well not be available. I hope that this paper will encourage the gas industry not only to make full use of the mobile frequencies already available to them, but will also promote the positive planning of radio telecommunication systems that can be used by the Radio Committee to substantiate the pressure for a block allocation of radio frequencies for fixed-point-to-fixed-point use.

Mr. Rimmer's paper very ably reviews the present state of radio communications practice and indicates its potential value to the gas industry.

The experiences and developments planned by the Wales Gas Board may be useful in adding to the story. The Board's first mobile radio system was approved in 1955. However, it was found that negotiation with the G.P.O. to obtain a frequency allocation was very laborious, and as a result the system did not actually come into operation until 1957.

In 1960, a further two mobile radio systems were commissioned, and the frequency allocations were obtained readily and without delay as a result of the work of the Radio Committee. I want to thank its members very much for what they have done.

Each of these systems, like many others, provides control from one control-room of fitters' vans at a number of separate medium-sized undertakings, urgent complaints at all the undertakings in each system being channelled to one common control-room.

The centralization of mobile control provides economy in operating costs—I am sure all members know this—and also in the use of radio frequencies. This latter point is very important in view of the limited number of frequencies available. Here, perhaps I might mention the map given as Figure 1, whereon may be seen what proves now to be quite a ridiculous allocation of six frequencies in the narrow area of South Wales. However, at the time it was proposed it seemed to be the only available solution of the problem of the complex network in South Wales, and it appeared that each undertaking would need a separate frequency and separate control, and that six frequencies would be needed in that small area.

It was found that coverage of a number of undertakings from one control-room in the difficult terrain, from a radio point of view, experienced in Wales could be most conveniently obtained by siting one aerial at the highest possible point in the area. Fortunately, other organizations have existing radio stations at several high points, and the Board has been able to negotiate space for equipment on existing masts at the most suitable of these sites ; for example, it has been possible to obtain radio coverage of some 300 sq miles in South East Wales from a local authority radio station situated at a height of 1,800 ft above sea level. The radio equipment is installed at this remote site and is operated from the Wales Gas Board's control-room by a rented G.P.O. land line.

I am sure I need not tell a meeting of The Institution of Gas Engineers that the economy of such a mobile control system is probably best considered in terms of annual cost per fitter's van, together with the productivity. The annual capital and operating costs of each van with radio equipment together with control-room costs allocated per van amount to approximately £350 per mobile fitter. The value of a mobile fitter, who does emergency work and other work as well, varies with local conditions. In general, each of these fitters is given a host of small jobs each morning (meter changes and all those jobs in which the unproductive time is high compared with the working time), and, between attending to emergency cases, the fitters carry out small work. It is being found that the amount of work done by a mobile fitter is equivalent to between 1.5 and 3 times the normal day's output of a non-mobile fitter on similar types of work. Thus, quite apart from the improved service provided, each mobile radio van results in a considerable increase in productivity, which is a matter of some importance in these days of shortage of skilled gas fitters.

Moving from the mobile system to the fixed-point-to-fixed-point system, the Board has been developing a telemetry system for the Eastern Section of the South Wales gas grid since 1954. The system operates through rented G.P.O. land lines, and its reliability has been most disappointing. In one year, interruptions of communication due to line faults numbered 140, these interruptions affecting one or more of 12 holder stations.

Because of the poor standard of reliability experienced with G.P.O. land lines for telecommunications in Wales—they may be better elsewhere—the possibility of using fixed-point-to-fixed-point radio links was first examined in 1956. Both what is loosely called u.h.f. (ultra high-frequency) and microwave systems were considered at that time, on the assumption that frequency allocations would be made, but it was found that there was no suitable home-produced radio or telemetry equipment available, and that importation of equipment from the United States of America was expensive to the point of being uneconomic.

Since 1956, the position has been continuously under review, and in 1959 it became apparent that suitable telemetry equipment based upon the recommendations of the Radio Committee would be available in 1960.

With the co-operation of the Radio Committee, it has now been possible to obtain a u.h.f. allocation for a telemetry and telecontrol system to be installed to control and monitor the Wales Gas Board's North Wales gas grid. The Board has been told, in effect, that it can have one system in Wales for the time being, to see how it goes. This will be used in North Wales where at the moment the need is greater than in South Wales.

Work upon a backbone system to control seven major reception stations and two grid supply stations is planned to commence shortly. The system will be capable of extension to include further stations supplied by the North Wales grid pipeline.

The telemetery system will be of a digital scanning type conforming to the draft specification of the Radio Committee, the time for one complete scan of all stations occupying less than 1 min., in which time 27 measured values and 60 alarms will be examined. The measured values will periodically be logged on an electronic typewriter, the logging periods being adjustable, to give a record of operations. The flow of gas into each station can be set and altered remotely from the control-room by raise and lower buttons through 5 per cent steps. Each out station can be selected and the measured values at that station then appear on a digital indicating panel. Scanning will be interruptible to allow speech between the control centre and any station. A repeater station will be necessary, sited at high level, through which all communication will take place, and a separate V.H.F. transmitter will be installed at the repeater with talk-through facilities to enable the grid controller to speak to mobile personnel by the interruption of telemetery to use the control station to repeater station u.h.f. channel as a link. Those members who were at the Institution's 96th Annual General Meeting at Llandudno may be interested that the one key point on which the Wales Gas Board must have a mast to serve North Wales is Great Ormes Head.

It is anticipated that this telemetery system using u.h.f. radio will cost about £500/annum per station inclusive of annual capital and operating costs of equipment and control centre.

The work of the Radio Committee of the Fuel and Power Industries is of great potential importance to the gas industry. Much use is already being made of mobile radio for emergency calls. It seems probable that there is room for an extended use of mobile radio vans not only to improve consumer service, but also to increase the productivity of gas fitters on certain types of work. Telemetering and tele-control by radio methods will be increasingly needed for the efficient operation of the industry's growing system of grid and transmission systems. Mr. Rimmer's well-timed and most informative paper will do much to encourage these developments and I congratulate him very sincerely for an excellent piece of work.

Col. W. H. Slack (Transport and Civil Defence Officer, North Western Gas Board) :—Those who have been intimately connected with the development and operation of V.H.F. radio for a number of years, particularly in the gas industry, for peaceful purposes, will be grateful to Mr. Rimmer for going to all the trouble of writing this paper, and, if I may say so as a member of a sister Institution, it does credit to The Institution of Gas Engineers to find time at an Autumn Research Meeting for such an innovation. It is a subject that is new ; electricians mix it up with all sorts of mumbo-jumbo and mysticism, making it so complicated that people are tending to be afraid to use it.

The author rightly says that his paper is in the nature of a review, but it represents a vast amount of work, not only by him, but also by the Committee to which he refers. I have attended its meetings on a number of occasions, and it's friendliness is commendable.

Mr. Rimmer deals with many of the advantages to be obtained from the use of radio, and refers in some measure to the difficulty of establishing the savings that accrue from its use. He mentions also that in one Division of the West Midlands Gas Board, about £7,000/annum has been saved by the use of mobile radio, and he goes on to say that, in addition, it has improved the service to the consumer in a very spectacular way. This in itself is justification of the use of V.H.F. radio. Anything that can be done to present efficiency to the consumer is justified. There is no doubt that the G.P.O. does not wish the gas industry to use radio in the form that it would wish, and as luxuriously as it might like. The Post

Office has a monopoly, and, as I see it, we are attempting to break that monopoly. What has been achieved so far by the Radio Committee is a wonderful victory. Mr. Rimmer and the Committee have fought hard against formidable odds to achieve what has already been won, and the gas industry should take advantage of the frequencies already offered and use them to the full.

Mr. Rimmer in his paper refers to 100 mobile equipments being used per base station or fixed station in the New World, and says that our average is something like 20. I think this is indicative enough of where we stand. Discipline over the air is, of course, something that we have to learn. It is not easy to speak, as the Americans apparently do, in monosyllables or codes. Our men want to pass the time of day, and do. I think, however, that as time goes on this will be eliminated.

In his paper, Mr. Rimmer comes out very strongly against the use of duplex equipments. The North Western Gas Board has used it since its inception. It went into the radio field to provide a facility that did not exist by any other method, and after a lot of thought, in which Mr. Frederick Bell was deeply involved, it was concluded that the nearest one could get to the ordinary telephone system and facility was what was wanted ; a duplex system gives precisely this. Any employee can use a duplex system, but a good deal more technique and experience are needed to use a simplex one. I am prepared to rest my case on the fact that the G.P.O. itself, with its recently inaugurated public mobile system has installed a full duplex network. The Lancashire County Constabulary, with well over 1,000 mobiles, uses a duplex system. The North Western Gas Board still intends, as time goes on, to integrate its V.H.F. network into its intercommunication system, and, as Mr. Rimmer so rightly says, duplex operation is the only way to do it.

With fixed-to-fixed radio links, we have the only guarantee to maintain a V.H.F. radio network in time of emergency. The Gas industry has made a special point to the G.P.O. that its system is needed for normal and for emergency purposes, with emphasis on the latter. [The G.P.O., in turn, has conceded the industries' right to use radio in a national emergency. If this country were attacked, the normal telephone network might be affected, and I think, therefore, that if one is relying on pairs of wires rented from the Post Office, one should have second thoughts on their possible vulnerability.

The other problem is, of course, the control of any national grid with which one might in future be concerned. I am positive, that a fixed-to-fixed link radio is the only reliable method that can give gas engineers, the service required.

Mr. F. Bell (Southampton) :—I am very happy to comment on Mr. Rimmer's paper on radio communication, especially as he tells us so much about the potentialities of radio, not only for communication, but for control duties as well.

For a number of years, many engineers have used mobile radio as an adjunct to an existing organization for controlling distribution and customer service personnel, but the author suggests that the most economical way is to use radio alone for these purposes.

He quotes £7,000/annum as a saving in one Division of the West Midlands Gas Board. I would be pleased to know what has gone into the make-up of this figure.

We learn from the paper that all the Electricity Boards and the National Coal Board have 100 per cent mobile coverage and that most of it is to the new 25 kc/s specification. Is this because they have had so much enthusiasm for the new specification that they have renewed their equipment as a routine procedure without waiting for the G.P.O.'s approval of the specification?

To operate a large number of mobiles satisfactorily, especially when they cover so many different types of operators, many of them working a considerable distance from their vehicles, selective calling, preferably on loud hailers, is essential. We learn from America that this type of selective calling is possible and is used extensively there. For a small number of mobiles, a call sign can be used, but, once the number exceeds 12 to 15 mobiles per station, even this becomes unwieldy, and it would be very interesting if Mr. Rimmer could give more details of the selective calling system, and say how soon it will be available.

The author's account of the use of U.H.F. and S.H.F. fixed radio links and details of their reliability is reassuring. Only a fortnight ago, I had a conversation with the General Manager of a water supply company covering a large area in the South of England who would like to use radio links for the control of pumping stations, but he cannot get a frequency allocation. Does it mean that the gas industry, can reasonably expect to get one of the two-frequency channels that have been made known to the G.P.O., or shall the industry have to fight for frequencies?

I am no recent convert to supervisory control of holder stations, and my own experience with supervisory remote control using G.P.O. land lines for the remote operation of holder stations, both in Liverpool and on the Aldershot grid, has been entirely satisfactory, quite different from the experience Mr. Hird has had in Wales, but more recently, on another system, some 15 per cent of the faults on the new system are attributable to G.P.O. land line failures.

If this is the pattern for the future of G.P.O. land lines, the use of U.H.F. fixed-point-to-fixed-point working becomes more and more attractive. Mr. Rimmer has indicated that, although two Area Gas Boards have taken up frequencies, the equipment is not installed, and one should have liked to know something about the reliability factor as applied to equipment operating in this country, in heavily populated areas, and, probably under industrial conditions. Are British conditions any different from those in America? Even for the operation of fixed-to-mobile equipment, considerable difficulty has been experienced in obtaining planning permission for elevated sites for the erection of aerials, and the choice of special sites for aerials to be used for fixed-point-to-fixed-point working will be even more limited. It seems inevitable that much more sharing of aerial masts will have to be accepted.

Finally, I make a plea that if the gas industry is to adopt fixed-point-to-fixed-point radio controls—and I am certain it has considerable potentialities, especially for distribution plant—then the makers of the radio equipment should be prepared to provide the whole of the sensing and coding equipment that will be required both for the control-room and the controlled station. Engineers want to be able to go to one firm, tell it their requirements, and have the whole of the work carried out by one organization, without employing a series of contractors.

I would particularly like to thank Mr. Rimmer and his Committee for the enormous amount of work that they have done, especially on fixed-point-to-fixed point radio working, and for the position in which the gas industry is today, especially with the negotiations with the General Post Office.

Written Reply

The **Author**, in reply, wrote :—Mr. Hird's contribution is indeed very timely, particularly with respect to the telemetering and telecontrol installations that are under consideration for North and South Wales. Needless to say, the Wales Gas Board is one of the Boards to which fixed-point-to-fixed-point allocations have been provisionally made by the G.P.O.

With regard to the unreliable land lines in Wales, I am quite sure that the Wales Gas Board's experience has been shared by other Boards throughout the country, although, probably, the difficulties have not been so severe. Probably, the most serious aspect of communication interruptions is the time required for repairs to be carried out on land lines.

Col. Slack has drawn attention to an error in the title of the Joint Radio Committee, and, of course, he is quite correct.* I would confirm Mr. Slack's comments that this Committee works in the most friendly of atmospheres ; each member, in turn, has at some time relegated his own interests in favour of the general requirements of the Committee. I would also acknowledge again the help that has been received from the Central Electricity Research Department.

Col. Slack presupposes, quite wrongly, that duplex equipments are not advised ; quite obviously, duplex working requires a fair amount of extra equipment, which has to be paid for. If the mobile system is being integrated into a telephone system, then the extra equipment is essential and the relative cost does not really

* The necessary amendments have been made to Communication 579 as printed in this issue.

enter into it. On the other hand, if a mobile system is to be operated without integration into a normal telephone system, then it would appear to be cheaper to train the personnel—which has to be done in any case—rather than to pay money for a service that does not provide more than the simplex system. The case that the G.P.O. has presented in order to justify duplex working, as mentioned by Col. Slack, is precisely what has been stated, namely, that the equipment is required to be integrated into a normal G.P.O. telephone system, and there is, of course, no alternative to duplex working.

Security of the radio service is as near 100 per cent as makes no matter, and Col. Slack rightly points to the use of this type of communication for emergency purposes in both peace and war. His concluding reference to the control of any national grid has not already gone without thought ; as stated in the paper, the Technical Panel is, in due course, to study a microwave backbone throughout the length of the country, which would be used on a shared basis by the three Industries.

Mr. Bell makes specific reference to the use of radio as a functional tool : this point has been made very clear in the paper, and mathematically one may be more strict in terming it a function of a function, the prime variable being communications.

With regard to the saving achieved by this method of working, I would state that the figure of £7,000 was obtained after careful consideration of reduction of labour and the increased productivity of the remaining labour.

With regard to the coverage achieved by the Area Electricity Boards, Mr. Bell makes the wrong interpretation of the information given. Firstly, the G.P.O. has given approval to the specification as produced by the manufacturers and approved the use of 25 kc/s channelling in advance of its own introduction of this reduced channel width. Complete changeover of this equipment by the Electricity Boards has not yet been made, but all their allocations have been taken up and are scheduled for completion and changeover within the next year or so.

With regard to the selective calling system, the equipment in use in America is very simple and is a combined electro-mechanical device ; it is arranged to trigger the horn on the vehicle should the attendant be absent on a job some distance away.

With regard to the allocation of fixed-point-to-fixed-point frequencies, it is not surprising that the water supply company, as mentioned by Mr. Bell, has not obtained a suitable allocation ; its position is precisely the same as that of any fuel and power Area Board prior to the formation of the Radio Committee. The present position is that six frequencies have been suggested by the G.P.O. for use by the combined undertakings, and that allocations are being made, without prejudice, pending the acceptance of a national plan by the industries : the national plan has now been submitted. Until such time as this plan has been agreed, it will be necessary to justify every application on the score of reliability, cost and/or line availability, but the Committee is there to make the case of a particular Area Board rather than the Area Board making its own case to the G.P.O.

Mr. Bell echos at least some of the experience of Mr. Hird with regard to faults on G.P.O. land lines ; there is no doubt that these occur and experiences are not unknown where duplicate land lines have been out together under repair for some considerable time. The stark fact has to be realized that the G.P.O. land line is a telephone communications instrument designed under the pressure of corresponding economics ; thus, whilst a conversation may be interrupted for a few hours, or possibly days, without serious consequence, the control of plant cannot be so treated. In other words, the G.P.O. land line, under these circumstances, is being used for a purpose for which it was not specifically designed : nevertheless, there are many people who still consider it reliable enough for this particular type of duty. The cost of it is, of course, a very different matter.

With regard to the reliability of radio equipment in heavily populated areas and under industrial conditions, there is no reason to believe that our conditions are any more arduous than those of the U.S.A., where, as is stated in the paper, they consider the radio method to be the most reliable of all their communications systems. The location of aerials is always something of a problem, but there are numerous instances, throughout the country, where various authorities share the aerial location.

Mr. Bell, in his concluding remarks, makes a plea for manufacturers to provide the whole of the sensing, coding and transmission equipments, and he can be assured that manufacturers have this at the forefront of their minds and are only too anxious to meet this condition if that is what is required ; at the same time, they have indicated that they are quite prepared to manufacture the component units as separate entities if this is also required. It may be stated that since the Committee started its work in this fixed-point-to-fixed-point field, a fairly large number of manufacturers have become interested in this type of equipment and, indeed, have taken out foreign licences from both the U.S.A. and the Continent of Europe.

EXPERIENCES WITH BRANCHED-FLUE AND SE-DUCT SYSTEMS FOR VENTING GAS APPLIANCES

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Research Communication GC72
(*Continued from p.* 56.)

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(*To be concluded.*)

IV (Continued)—THE SE-DUCT SYSTEM

(2) MEASUREMENTS AFTER OCCUPATION

The objects of the long-term instrumentation were two-fold :—

(*a*) *Appliance Usage.* In designing the system, data are required on the maximum number of appliances likely to be in use simultaneously, and their proximity to the terminal. Appliance-usage recorders were installed to provide such data, which were not available elsewhere.

(*b*) *Flow and Temperature Conditions in the Duct.* The calculation of the required duct area for a given number of appliances has, in the past, been based on the assumption that flow would be induced only by operation of the appliances ; wind effects and thermal effects due to the occupation of the dwellings have been ignored. It was important to establish the significance of these additional factors.

The form of the information obtained from the records of the various instruments is shown in Figure 7, which is a transcription of the individual records from Gateshead on a common time base, for the periods of 9 a.m., 28th October, to 3 a.m., 30th October, and 7 p.m., 12th November to noon, 13th November, 1959. The individual records are summarized in the following sections.

(A) APPLIANCE USAGE

The usage of the appliances during the periods covered by Figure 7 is representative of the general pattern at Gateshead and Islington, in which periods of peak usage occurred at

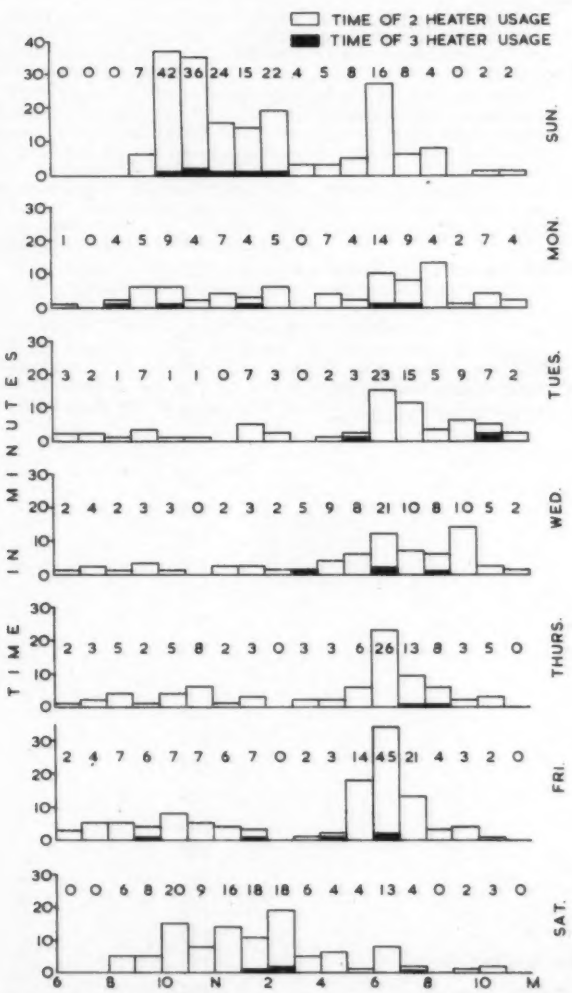


FIGURE 8.—*Gateshead: Simultaneous Usage of Water Heaters.*

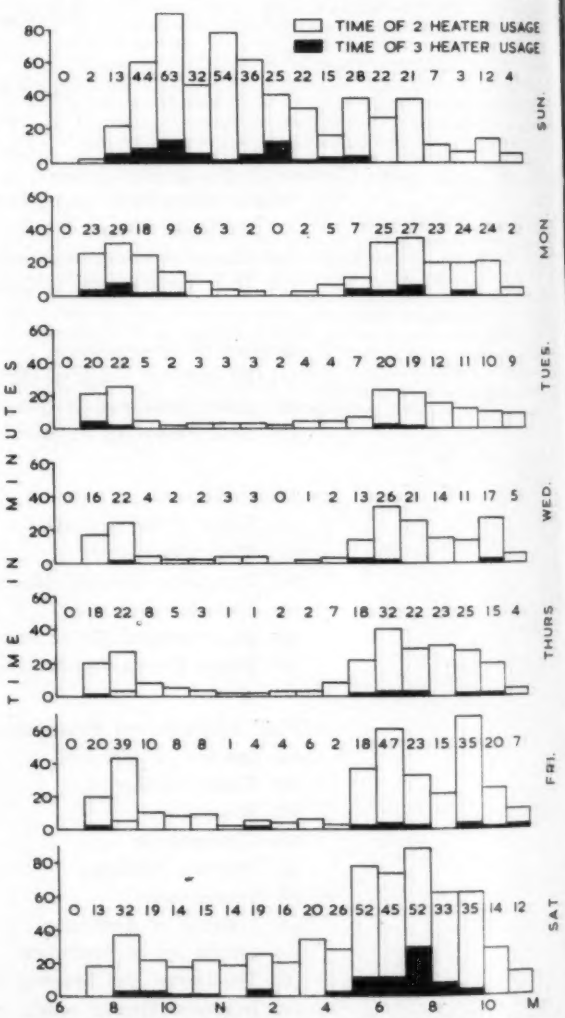
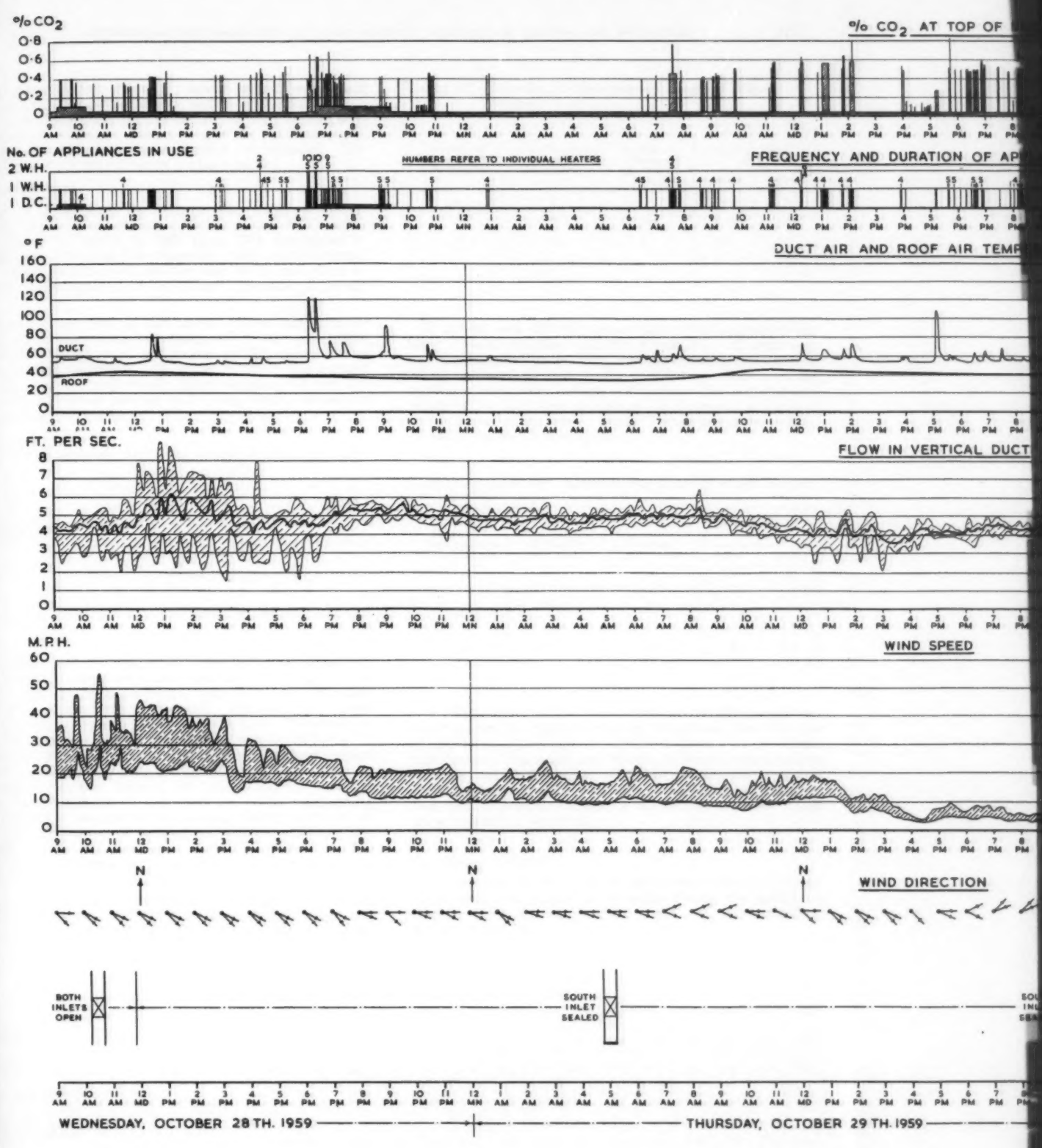


FIGURE 9.—*Islington: Simultaneous Usage of Water Heaters.*


% CO_2
0·8
0·6
0·4
0·2
0
% CO_2 AT TOP OF
No. OF APPLIANCES IN USE
2 W.H.
1 W.H.
1 D.C.
NUMBERS REFER TO INDIVIDUAL HEATERS
FREQUENCY AND DURATION OF AP
°F
160
140
120
100
80
60
40
20
0
DUCT
ROOF
DUCT AIR AND ROOF AIR TEMP
FT. PER SEC.
8
7
6
5
4
3
2
1
0
FLOW IN VERTICAL DUCT
M.P.H.
60
50
40
30
20
10
0
WIND SPEED
N
N
N
WIND DIRECTION
BOTH INLETS OPEN
SOUTH INLET SEALED
WEDNESDAY, OCTOBER 28TH. 1959
THURSDAY, OCTOBER 29TH. 1959

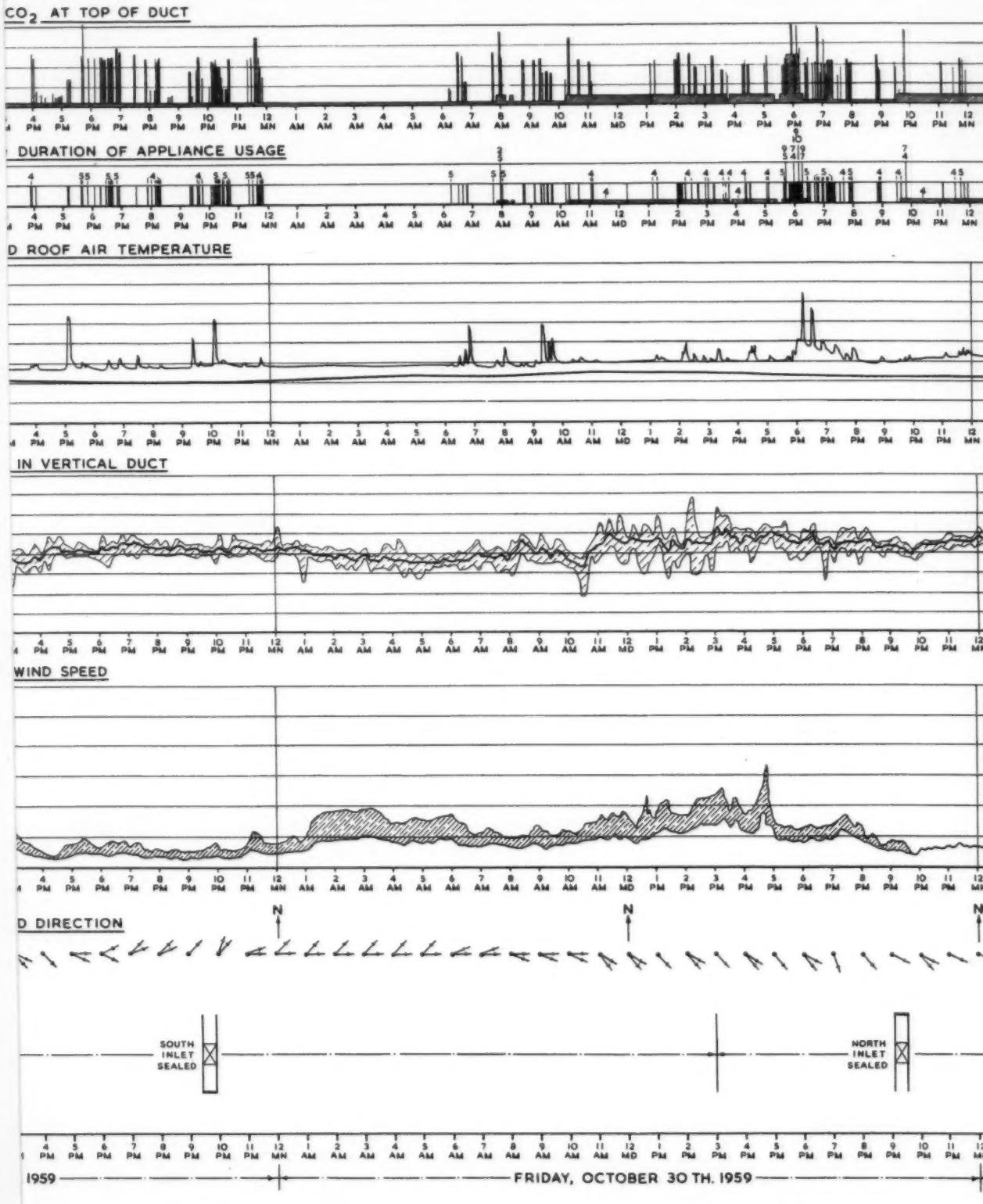
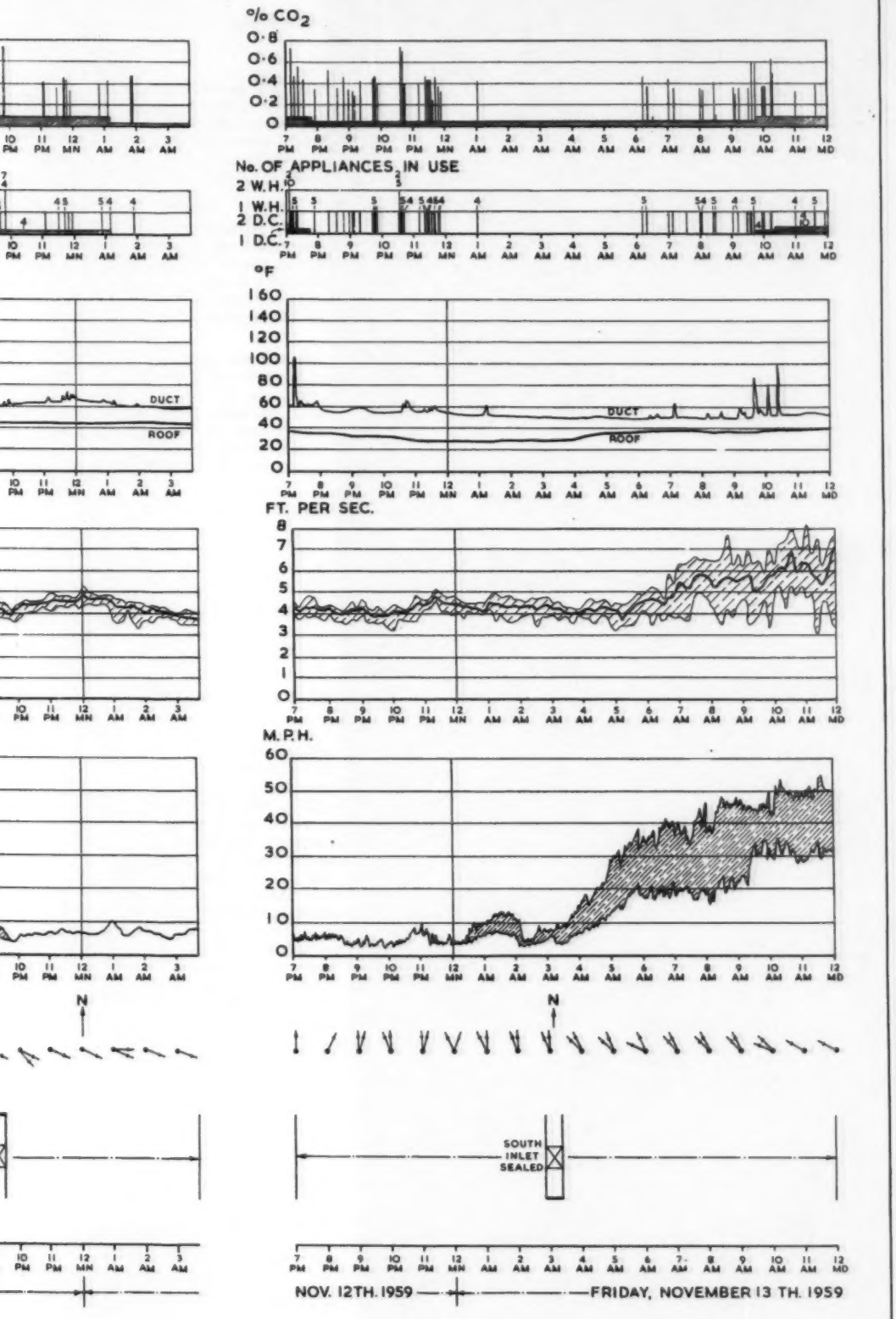


FIGURE 7. — *Gateshead : Instrument Records.*


% CO_2
0·8
0·6
0·4
0·2
0
No. OF APPLIANCES IN USE
2 W.H.
1 W.H.
2 D.C.
1 D.C.
°F
160
140
120
100
80
60
40
20
0
DUCT
ROOF
FT. PER SEC.
8
7
6
5
4
3
2
1
0
M.P.H.
60
50
40
30
20
10
0
N
SOUTH INLET SEALED
7 PM 8 PM 9 PM 10 PM 11 PM 12 MN 1 AM 2 AM 3 AM 4 AM 5 AM 6 AM 7 AM 8 AM 9 AM 10 AM 11 AM 12 MD
NOV. 12TH. 1959
FRIDAY, NOVEMBER 13 TH. 1959

certain times during the day. Every operation of each heater and its duration are shown, and for appliances 4 and 5 the detailed pattern has been extracted. It may also be seen that, at times, two water heaters were in use simultaneously, and the particular appliances concerned are indicated. The use made of the drying cabinets is also recorded.

(i) *Water Heaters*

Table 14 summarizes the average daily usage of the individual heaters at Gateshead during a period of 23 weeks comprising 13th March to 28th June, 27th September to 24th October, 1959, and 31st December, 1959, to 6th January, 1960. It will be observed that the ratio of the maximum to minimum consumptions of individual appliances is nearly 10 : 1.

The total usage time of the heaters varied, according to the day of the week, from an average of 13·6 min. per heater on Sundays to 9·4 min. per heater on Thursdays. The average weekly usage was 1·26 hr per heater. The average draw-off times for each heater varied between 0·8 and 1·5 min., with an overall average of 1·1 min. and a maximum for any heater of 33 min.

TABLE 14.—*Gateshead : Individual Usage of Water Heaters.*

Water Heater No.	1	2	3	4	5	6	7	8	9	10
Average Number of Operations per day ..	3·4	4·6	1·8	17·3	20·8	2·8	11·3	11·8	7·2	13·1
Total Usage Time (min./day) ..	5·1	5·9	2·5	21·4	18·3	2·2	17·5	16·2	6·3	14·8
Average Consumption (therms/week)	0·57	0·67	0·28	2·43	2·09	0·25	1·99	1·84	0·71	1·69

Very few draw-offs exceeded a few minutes' duration ; nevertheless, arising from a conventional way of life of the tenants, periods of a relatively high frequency of usage occurred at certain times of the week. This resulted in more than one heater being in use simultaneously. The pattern of simultaneous usage is summarized in Figure 8 and Table 15, from which the total time per week that two or three heaters were in use together during the period of 23 weeks may be obtained during any hour of the week, together with the corresponding number of occasions on which overlapping has occurred. Maximum overlapping clearly occurred at meal times and times of bathing and clothes washing. On average, two heaters overlapped about five times a day for about 1 min. on each occasion, and more than two overlapped rarely and then for a time not exceeding 1·2 min.

Similar figures were obtained for the usage of the water heaters at Islington. Table 16 gives the individual usages in a period of 21 weeks from 18th February to 14th July, 1960.

TABLE 15.—*Gateshead : Simultaneous Usage of Water Heaters.*

Number of Heaters in Use Simultaneously	Total Duration of Overlap (min./week)	Number of Overlaps per week	Overlap Times (Min.)	
			Mean	Max.
1	2	3	4	5
2	29	35·5	0·8	6·5
3	1	2	0·5	1·2
4	Occurred only twice		0·25	0·2

It can be seen that the consumptions here are somewhat lower than at Gateshead and the average draw-off times vary over the range 0·7 to 1·3 min. with the exception of heater 4, whose value of 4·5 min. could clearly be attributed to the appliance being used mainly for baths. The simultaneous usages of two and three appliances are illustrated in Figure 9 for each hour of the week. Table 17 summarizes the overlap times during the 21-week period.

TABLE 17.—*Islington : Simultaneous Usage of Water Heaters.*

Number of Heaters in Use Simultaneously	Total Duration of Overlap (min/week)	Number of Overlaps per Week	Overlap Times (min.)	
			Mean	Max.
1	2	3	4	5
2	116·2	86·6	1·3	9
3	9·6	7·1	1·4	5
4	0·5	0·4	1·3	2

It will be observed that the incidence of multiple usage was much greater at Islington than at Gateshead, and this can be attributed to the greater number of heaters at the former installation. The mean and maximum overlap times exhibit different characteristics at the two installations, but too much reliance should not be placed on the figures for three and four appliances, because of the infrequency with which these conditions occurred.

(ii) *Drying Cabinets*

Similar data on the usage of the drying cabinets at Gateshead for a total period of 30 weeks during the period 1st March, 1959, to 6th January, 1960, are summarized in Tables 18 and 19.

TABLE 16.—*Islington : Individual Usage of Water Heaters.*

Average Water Heater No. ..	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B	7A	7B	8A	8B	9A	9B	10A	10B
Average Number of Operations per day	4·4	7·5	5·4	0·5	8·0	5·2	5·2	3·6	7·1	3·5	4·7	7·3	3·1	14·4	8·9	9·1	5·6	3·6	9·7	9·8
Total Usage Time (min./day) ..	4·3	8·6	6·5	2·3	8·3	7·5	4·9	5·5	9·4	4·9	4·9	5·6	2·5	14·1	7·7	7·0	4·9	4·8	10·7	8·8
Average Gas Consumption (therms/week)	0·50	0·97	0·74	0·26	0·94	0·86	0·56	0·63	1·06	0·56	0·56	0·64	0·28	1·61	0·88	0·79	0·56	0·55	1·21	1·01

TABLE 18.—*Gateshead : Individual Usage of Drying Cabinets.*

Cabinet No.	1	2	3	4	5	6	7	8	9	10	Total
Total Usage Time (hr/week) ..	0·03*	4·1	2·8	24·0	2·3	2·1	10·0	8·7	0·6	4·7	59·3
Average Consumption (therms/week)	0·003	0·39	0·26	2·28	0·21	0·20	0·95	0·83	0·06	0·45	5·63

* Pensioners occupied the ground floor flats.

TABLE 19.—*Gateshead : Simultaneous Usage of Drying Cabinets.*

Number of Heaters in Use Simultaneously	Total Duration of Overlap (hr/week)	Number of Overlaps per week	Overlap Times (Hr)	
			Mean	Max.
1	2	3	4	5
2	8·4	7·8	1·07	4·8
3	1·2	1·6	0·75	2·5
4	0·06	0·1	0·42	0·9

The total usage time again varied according to the day of the week, being highest on Saturdays, Sundays, and Mondays with a maximum of 1·07 hr per cabinet on Saturdays. The minimum of 0·64 hr per cabinet occurred on Wednesdays.

(B) FLOW CONDITIONS AT GATESHEAD

For a full study of the flow conditions in the system, information was required of the velocity and direction of the free wind stream and of the associated pressures produced at the openings of the system. The latter may be calculated from the known flows in the horizontal and vertical branches of the system, and, in addition, the local wind velocities may be estimated.

A wind incident on a built-up area is likely to produce a change in the wind characteristics not only within the area, but also for some distance above it. Ideally, therefore, the wind characteristics should be measured at a position that is both exposed and remote from any obstacles in the wind path. To obtain guidance on the general wind conditions in the Gateshead area, data were obtained from the meteorological station of the Tyne Improvement Commission at South Shields, some 10 miles east of the block.

The block at Gateshead, shown in plan in Figure 10, stands on one of the higher parts of the neighbourhood, and from the local topography the degree of exposure is high for winds directed from the north to east quadrant. For such winds, good agreement has been obtained between the wind speed calculated as indicated above and that recorded at the meteorological station.

(i) *Without Appliances in Use.*

The duct air velocity was measured at a point 70 ft above the base by a hot-wire anemometer of sufficient sensitivity to record fine variations in the flow lasting for only a few seconds ; these almost instantaneous values were recorded at 1-min. intervals. The range of these velocities is shown in Figure 7 for a period in which the mean free wind speed varied from 5 to 40 m.p.h. and from all directions apart from north-east. It will be observed that, whereas the instantaneous velocities of the duct air varied between 2 and 9 ft/sec, the average figures lay between 3·5 and 7 ft/sec. Indeed, during the whole period of 18 months in which records were obtained, the average velocity of the air flow through the vertical duct varied remarkably little.

Under calm conditions, the range of the instantaneous velocities was small, and, except for short periods, the average velocity lay between 3 and 4 ft/sec. Since the hot-wire anemometer is not directional, the instrumentation under these conditions was supplemented by a directional-flow record at the base of the duct. This showed that, for a total time of 50 min. comprising four periods in the summer, downflow of very small magnitude occurred at the base. However, analyses of the two anemometer records and the record of carbon dioxide lead to the conclusion that, during these periods of near-stagnation, the flow in the main part of the duct was upwards, whilst at the lower end it was fitfully downwards due to leakage of air into the duct.

The prevailing upward velocity of 3 to 4 ft/sec under calm conditions was increased slightly by winds of up to about 20 m.p.h. in certain directions and up to 10 ft/sec for north to east winds of 40 m.p.h. Apart, therefore, from the periods of high wind speed, during the 18 months of the records the average velocity was approx. 4 ft/sec. High-speed winds between north and east produced velocities in the horizontal duct of up to 16 ft/sec, whilst winds of comparable intensity from the south and west resulted in horizontal velocities between 1 and 7 ft/sec.

With a view to possible simplification of the air inlet arrangements, observations were made of the effects of closing one air inlet. Six of the ducts at Gateshead were in operation with only one inlet open for eight months ; these were selected so that some single inlets would be exposed to windward and some to leeward conditions for almost all wind directions. Inspection of the ducts and the appliances on them showed that their condition was no different to that of the ducts with two inlets open and their appliances.

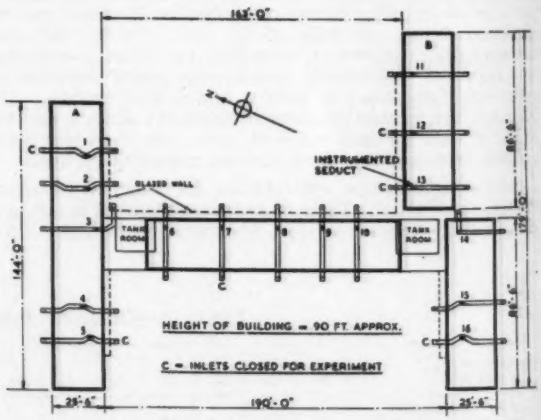


FIGURE 10.—*Gateshead: Layout of Base Ducts.*

Duct 14 in Figure 10 has both inlets open on the south side of the building, so that for north winds the inlets are both in a leeward zone. This system has operated satisfactorily since

the occupation of the flats approximately 23 months ago. Detailed measurements were made over the whole period when only one inlet of the instrumented duct was open. With the north inlet open, an upward velocity of 7 to 8 ft/sec was recorded for a mean wind speed of 40 m.p.h. from the south east, and a velocity of 4 to 5 ft/sec for a wind speed of 35 m.p.h. from the west. With the south inlet open, an upward velocity of 4 ft/sec was recorded for westerly winds and 7 ft/sec for a wind speed of 20 m.p.h. from the east. During a 100-hr period, and with the wind speed in excess of 20 m.p.h., the directional flow record at the base of the vertical duct showed momentary downward flow pulses.

At Islington, one inlet to the straight-through base limb was blocked off for four months. Although detailed flow rates were not recorded, no significant change could be detected in the carbon dioxide values for this period, as compared with the earlier operation with both limbs open.

(ii) *With Appliances in Use*

Table 20 gives seasonal variations of the maximum, minimum and mean values of the concentration of carbon dioxide in the duct for individual heaters.

TABLE 20.—*Gateshead : Concentrations of Carbon Dioxide with Individual Water Heaters in Use.*

Period		Concentration of Carbon Dioxide (per cent)				
		Heater No. : 1	3	5	7	9
12.3.59 to 19.3.59	Av.	0·30	0·32	0·32	0·37	0·37
	Min.	0·23	0·32	0·23	0·30	0·26
	Max.	0·36	0·33	0·40	0·50	0·48
29.6.59 to 4.7.59	Av.	0·39	0·36	0·43	0·48	0·43
	Min.	0·37	0·30	0·40	0·38	0·38
	Max.	0·50	0·39	0·50	0·57	0·50
25.9.59 to 1.10.59 and 2.11.59 to 9.11.59	Av.	0·35	0·38	0·44	0·47	0·43
	Min.	0·29	0·37	0·38	0·39	0·37
	Max.	0·53	0·41	0·48	0·54	0·50
18.1.60	Av.	0·36	—	0·40	0·45	0·44
	Min.	0·25	—	0·32	0·34	0·40
	Max.	0·43	—	0·50	0·56	0·48
Average for the Period		0·36	0·35	0·42	0·46	0·44
Average Velocity for the period (ft/sec)		6·7	6·7	5·6	5·1	5·4
Predicted Velocity (ft/sec) ..		4·2	4·1	3·8	3·4	2·6

The values in Table 20 show that the average concentration of carbon dioxide decreased slightly with increase in the distance of the appliance in use from the terminal. It might also be significant that, during the March, 1959, period, when there were persistent high winds, the carbon dioxide values were consistently low, and the minimum carbon dioxide value for each individual appliance was not related to the particular heater in operation.

The presence of a basic upward flow in the duct, of some 4 ft/sec, has resulted in a substantial levelling of the maximum carbon dioxide values when individual water heaters are in use. Apart from the values during the March, 1959, period, the tabulated maximum carbon dioxide values for all the heaters vary by less than 25 per cent. Apart from No. 1 heater during June to July, 1959, the minimum observed velocity is above that calculated on the assumption that the flow was due to the thermal input to the duct air by the appliance alone ; for heater No. 9, the minimum observed velocity was some 50 per cent higher than this predicted value.

Table 21 summarizes the concentrations of carbon dioxide in the duct air when two water heaters were in use simultaneously during the period March to November, 1959. The observed concentration of carbon dioxide for any two heaters may be obtained from Table 21 by selecting one heater from the top row and the other from the first column. The data in Table 21 show that the mean concentration of carbon dioxide varies only slightly with appliance level.

TABLE 21.—*Gateshead : Concentration of Carbon Dioxide with Two Water Heaters in Use.*

Water Heater No.	1 to 4	5 to 8	9 and 10
	Mean Concentration of Carbon Dioxide (per cent)		
1	2	3	4
1 to 4	0·62	0·69	0·70
5 to 8	0·69	0·77	0·75
9 and 10	0·70	0·75	0·72

Similar data from Islington (Table 22) for a period of 21 weeks from February to July, 1960, again show the same small variation in the mean values, which are almost independent of the particular two heaters in use.

TABLE 22.—*Islington : Concentration of Carbon Dioxide with Two Water Heaters in Use.*

Water Heater No.	1 to 4	5 to 8	9 and 10
	Mean Concentration of Carbon Dioxide (per cent)		
1	2	3	4
1 to 4	0·48	0·52	0·49
5 to 8	0·52	0·49	0·56
9 and 10	0·49	0·56	0·53

On the few occasions during a period of 23 weeks at Gateshead when three water heaters were in use simultaneously, the concentration of carbon dioxide varied between 0·8 and 1·1%.

(c) Duct Temperatures at Gateshead

(i) *Without Appliances in Use.*

Figure 7 shows the temperature of the air 4 ft below the terminal, and the external air temperature at roof level. When the duct structure had not been heated by products of combustion from the appliances, the duct air temperature remained remarkably constant and almost independent of both the external air temperature and the velocity of the duct air. This stability of the duct air was present throughout the recorded period, although, as shown by the temperatures in Table 23, there were seasonal variations.

TABLE 23.—*Gateshead : Ambient Air and Duct Air Temperatures.*

Period	External Air Temperature (°F)			Duct Air Temperature (°F)			Increase in Duct Air Temperature from Inlet to Top (°F)	
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.
1	2	3	4	5	6	7	8	9
3. 4.59 to 11. 5.59	58	34	46	60	54	57	20	0
1. 6.59 to 28. 6.59	68	50	59	73	63	68	21	0
20. 7.59 to 2. 8.59	68	50	59	70	66	68	19	—
25. 9.59 to 26.10.59	61	40	50	70	62	66	18	2
26.10.59 to 28.10.59	48	43	45	67	65	66	23	14
10.11.59 to 15.11.59	44	40	42	56	53	55	25	11
17. 3.60 to 27. 3.60	44	33	38	54	45	50	17	10
7. 4.60 to 25. 4.60	61	35	48	62	58	60	19	0
24. 5.60 to 30. 5.60	69	44	56	65	59	62	18	0

The last two columns in Table 23 show the range of the temperature rise of the duct air for each period. The data include both calm and windy conditions, with one and two ground-level inlets open.

(ii) *With Appliances in Use.*

Operation of one water heater resulted in a rise in the air temperature at the top of the duct, from about 5° to 80°F, according to the distance of the appliance from the top of the duct. The values of temperature rise in Table 24 are based on a selection of the records throughout the period 3rd April, 1959, to 30th May, 1960.

TABLE 24.—*Gateshead: Rise in Duct Air Temperature due to Operation of Water Heaters.*

Heater No. ..	1	2	3	4	5	6	7	8	9	10
Mean Rise (°F)	6	5	8	8	9	9	17	19	24	64
Max. Rise (°F)	9	8	11	16	14	13	21	26	27	82
Min. Rise (°F)	·3	4	6	6	6	8	10	10	12	40

From the values in Table 24, the increments due to operation of the lower five appliances were small and showed little variation, but the increment rose when heaters near to the top were in operation.

(3) ANALYSIS OF OBSERVATIONS

(A) DIVERSITY OF USAGE OF THE APPLIANCES

The data obtained from Gateshead and Islington on periods of usage of individual water heaters during the peak periods enable theoretical values to be deduced of the probable time that a specified number of heaters will be in use simultaneously. It can be seen from Table 13 that for the 10 heaters at Gateshead the simultaneous usage of three or more heaters occurs for only about 1 min/week and simultaneous usage of two heaters occurs for 30 min/week. There are 45 different combinations of two heaters for a duct with 10 heaters, so that, on average, any particular combination of two will be in use for an average period of $\frac{2}{3}$ min./week and for a maximum of perhaps 10 times this period. It is apparent, therefore, that design should be based for this degree of usage on the simultaneous operation of only two heaters.

Having established the proportion of the heaters likely to be in operation simultaneously, additional design information is required on the level of the appliances from the top of the duct. For two heater operation, any combination may occur for a significant time. In this case, therefore, the uppermost two heaters would be selected for design purposes.

It is recognized that the usages of the water heaters at both Gateshead and Islington are below the figures generally quoted, and that a higher frequency may be expected in other installations. This possibility is considered theoretically in Appendix 3, in which it is shown that, with a very high standard of usage, design of ducts serving six, 11, 16, 22 and 29 heaters can be based on two, three, four, five and six appliances respectively.

(B) DUCT FLOWS AND TEMPERATURES UNDER CALM CONDITIONS

The flow and temperature conditions in the duct are determined by the rate at which heat passes into the duct air and by the wind effect. Contributions to the former are provided by heat transfer between the duct air and the duct walls and by products of combustion from pilot flames and from the appliances. It is shown, in Appendix 5, that, for ducts with inlets at opposite aspects under calm conditions, the overall flow equation may be derived by summing the thermal energy contributions from the three sources and equating with the energy required to overcome the resistances to flow. The temperature increments are also additive. The effect of wind varies with the pressure distribution around the building, and for a specified pressure distribution varies according to the relative magnitude of the thermal contributions. The wind effect is, thus, not directly additive to the thermal effect, and other methods of analysis are required; a full analysis is given in Appendix 5. For a single-inlet system, the four energy terms are additive.

(i) *Without Appliances in Use*

Flow in the duct under these conditions is induced by the first two thermal effects only. It may be shown that, when the pilot jets are not in use, the inner wall surface of the vertical duct reaches an equilibrium temperature approximately midway between the temperature of the immediate surroundings of the duct (t_e) and the mean external air temperature (t_a). During the passage of the air through a tall duct, it is heated (or cooled), and at the top the air temperature is close to that of the wall, that is, the temperature rises by approximately $0{\cdot}4(t_e - t_a)$.* The effect of alternations about the average daily air temperature and short-period variations in the temperature of the duct surroundings may again be shown to be small owing to the high thermal capacity of the structure. It follows that the air temperature at the top of the duct would have a stable daily value. As this temperature is determined by the difference in temperature between the duct surroundings and the external air, it follows also that there would be seasonal variations.

At Gateshead, the temperature increment at the top of the duct due to the pilot jets that were in use should be approximately 10°F. Apart from days when the external air temperature was high, the value of $(t_e - t_a)$ was probably 10° to 20°F. For the average value, the air temperature at the top of the duct due to both temperature increments would be expected to be 16°F. From Table 23, during the period 25th September, 1959, to 25th April, 1960, the temperature at the top of the duct was between 12° and 21°F above the average air temperature, with an average of 14°F. Similar analysis may be used to deduce the effects of high external air temperature on the temperature of the duct air and to interpret the last two columns.

It can be calculated that the flow velocity induced by the heat transfer through the duct walls alone is 1 to 3·7 ft/sec for values of $(t_e - t_a)$ from 1° to 33°F; the velocity induced by the heat from the pilot lights alone is 2·5 ft/sec; and the velocity induced by the heat from both sources simultaneously is 2·5 to 4·2 ft/sec. This predicted range of velocities agrees very closely, apart from exceptional velocities during the summer, with the recorded range. The exceptional velocities probably occurred when t_e was less than t_a. When the external air temperature rises, the duct wall temperature will lag, so that conditions conducive to downward flow are established. Prior to the occupation of the dwellings during October and November, 1958, such conditions occurred fairly frequently. During this period, the normal recorded velocity was upwards between 1 and 1·5 ft/sec, but for periods of up to 8 hr the flow appeared to be alternating in direction and varying in velocity from approximately 0 to 1 ft/sec. The causes of the instability of this flow are discussed in Appendix 5. Co-incident with occupation of the flats, the normal velocity increased to about 4 ft/sec, and this inversion effect ceased. When the dwellings were occupied, the value of t_e would increase and, correspondingly, the temperature of the inner wall of the vertical duct. This would offset the effect of an increase

*This value applies strictly for a duct of 1 sq. ft area and over 70 ft high. Approximate values for other dimensions may be calculated as described in Appendix 5.

in external air temperature above the mean value. As the pilot burners were also alight, this thermal energy would further offset the possibility of downflow. It may be shown that, with the combined thermal effects, an unstable flow condition would occur only if the air temperature were to rise by some 20°F in a few hours.

(ii) *With Appliances in Use*

Operation of an appliance increases the energy already being supplied to the duct air. The magnitudes of the energy contributions due to duct walls, pilot flames and appliances have been calculated for a variety of combinations of water heaters in use by the methods described in Appendix 5. These values and the corresponding flow velocities induced by the supply of energy to the duct air are given in Table 25 for conditions in which energy is being supplied by the appliances alone and by the duct walls and the pilot flames. Since the individual energy contributions are inter-dependent, the values in the table, which apply for different conditions, are not additive.

Table 26 shows the calculated temperature rise of the air during its passage through the duct due to the three heat sources. These increments are additive.

The values show that, with up to three heaters in use simultaneously, the temperature rise at the top of the duct due to heat transfer through the duct walls and to the pilot flames, varies by only a few degrees. The temperature rise due to the appliances varies with the position and the number of appliances in use, from a minimum value of 22°F (when the lowest appliance alone is in operation) up to a maximum value of 97°F when the uppermost three heaters are in use simultaneously. Apart from the observed value in Table 24 of 82°F for the top heater, which is possibly high due to the thermocouple being about 18 in. above the flue outlet of this heater, the values in Table 26 are in conformity with the maximum observed figures.

The velocity and temperature of the air flow through the vertical duct may be shown to be not very different for ducts with two inlet branches or with one. At Gateshead, the closure of one inlet would increase the flow resistance of the system by approximately 13 per cent and increase the concentration of carbon dioxide by a similar proportion. The temperature rise of the duct air due to the pilot lights and the appliances would increase also by about 13 per cent, but the temperature rise due to heat transfer through the duct walls is largely independent of the flow rate through the duct and would remain almost unchanged.

TABLE 25.—*Gateshead : Energy Values and Induced Flow Rates from Thermal Sources.*

a = Appliances alone.
b = Duct walls ($t_e - t_a$ = 10°F).
c = Duct Walls ($t_e - t_a$ = 20°F).
d = Pilot lights.

Appliances in Operation	Energy (ft. lb/lb mass flow)							Velocity (ft/sec)				Concentration of Carbon Dioxide (per cent)			
	a	b	c	d	a and b	a and d	a, c and d	a	a and b	a and d	a, c and d	a	a and b	a and d	a, c and d
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Nil	—	0·44	0·82	0·70	0·44	0·87	1·52	0	2·0	2·8	3·5	Nil	Nil	Nil	Nil
No. 10	0·59	0·43	0·81	0·64	0·92	1·16	1·78	2·2	3·8	3·1	3·8	1·07	0·84	0·76	0·62
No. 9	1·12	0·41	0·79	0·56	1·43	1·61	2·19	3·1	3·5	3·7	4·3	0·76	0·67	0·64	0·55
No. 6	2·12	0·40	0·79	0·49	2·44	2·58	3·13	4·3	4·6	4·7	5·2	0·55	0·51	0·50	0·45
No. 4	2·98	0·39	0·78	0·43	3·29	3·37	3·90	5·1	5·3	5·4	5·8	0·46	0·45	0·44	0·41
No. 10, 9	1·43	0·40	0·79	0·51	1·65	1·83	2·31	3·5	3·8	4·9	4·4	1·25	1·24	1·17	1·07
No. 9, 8	2·12	0·40	0·79	0·49	2·40	2·51	3·08	4·3	4·5	4·6	5·1	1·10	1·05	1·02	0·93
No. 6, 5	3·60	0·37	0·75	0·40	3·85	3·90	4·43	5·5	5·7	5·8	6·2	0·86	0·83	0·81	0·76
No. 1, 2	4·72	0·38	0·75	0·37	4·93	4·94	5·52	6·4	6·5	6·5	6·9	0·74	0·73	0·73	0·68
No. 10, 9, 8	2·26	0·40	0·77	0·47	2·60	2·66	3·22	4·4	4·7	4·8	5·3	1·61	1·50	1·47	1·33
No. 9, 8, 7	3·09	0·37	0·77	0·43	3·35	3·43	4·02	5·1	5·4	5·4	5·9	1·38	1·31	1·31	1·20
No. 6, 5, 4	4·95	0·37	0·75	0·36	5·23	5·23	5·70	6·5	6·7	6·7	7·0	1·09	1·05	1·05	1·01
No. 3, 2, 1	5·94	0·36	0·73	0·34	6·29	6·29	6·70	7·1	7·3	7·3	7·6	1·00	0·97	0·93	0·93

From the point of view of the design of the system, the significance of the various energy sources may be more readily assessed from the corresponding carbon dioxide values. These show that, when one appliance is in use, the thermal contributions due to the duct walls and pilots reduce the concentration of carbon dioxide ; in the case of the top heater, the reduction is nearly 50 per cent. The same contributions have a much smaller effect on the concentrations of carbon dioxide in the case of any of the lower heaters, as these alone contribute comparatively large energies. For any of the 10 heaters, the carbon dioxide values with all energy sources operating lie within the range 0·51 ± 0·11 per cent, that is, a variation of ± 22 per cent in the mean carbon dioxide value. This mean carbon dioxide value and the variation in this value are in accordance with the maximum observed values in Table 20, which correspond to calm conditions.

With two appliances in operation simultaneously, the aggregate contributions from the appliances are larger, and, apart from the upper pairs of heaters, the reduction in concentration of carbon dioxide due to other thermal sources becomes small.

With three appliances in operation, apart from the uppermost three heaters, the concentration of carbon dioxide is within the range 1·06 ± 0·13 per cent, a result also in accordance with the observed values.

TABLE 26.—*Gateshead : Temperature Rise at the Top of the Duct* (°F).

Numbers of Appliances in Operation	Temperature Increment (°F)			
	From Duct Wall ($t_e - t_a$ = 20°F)	From Pilot Lights	From Appliances	Total
1	2	3	4	5
Nil	7·5	7·3	0	15
10	7·3	6·8	40	54
9	7·2	6·3	33	46
6	7·2	6·5	19	31
1	7·0	4·8	10	22
10, 9	7·2	6·1	65	78
9, 8	7·2	5·4	53	66
6, 5	6·9	4·7	33	45
1, 2	6·9	4·3	19	30
10, 9, 8	7·0	5·4	85	97
9, 8, 7	7·0	5·0	68	80
6, 5, 4	6·9	4·2	42	53
3, 2, 1	6·7	3·4	29	39

(c) Duct Flows and Temperatures under Wind Conditions

The flows through any flue system are determined by the combined effects of the wind pressures produced at the openings and the thermal effects. An interpretation of the recorded data, when both effects were present, may be derived from initial considerations of the effects of wind alone.

(i) *Without Appliances in Use*

The magnitudes of the pressures produced by wind around a building vary with the shape and exposure of the building, the direction and, possibly, the speed of the wind, and, under gusty conditions, with the changing wind pressures at three points which may be perhaps 100 ft apart. Data are available from experimental studies with models [11] on the magnitudes of pressure distributions under steady wind conditions for buildings with maximum exposure. Supplementary laboratory tests have been made, with a full-scale model of a section of the roof at Gateshead, in order to determine the conditions at the terminal.

The subject is dealt with in detail in Appendix 4, where the pressure conditions and, hence, the flow in the vertical duct are considered in relation to the pressures obtaining at the openings of the base limbs and at the terminal. The pressure at the base of the vertical duct is shown to be almost neutral relative to the external ground level pressures, and this, in combination with the low suctions observed at the terminal in the laboratory tests accounts for the small range of recorded velocities : for example, if the wind speed is 40 m.p.h., a pressure typical of those observed in the model tests at the windward opening will be 0·78 in. w.g. and that the leeward opening 0·39 in. w.g., but the pressure at the base of the vertical duct is only 0·02 in. w.g. The suction at the terminal varies from 0 to 0·2 velocity heads, and, hence, the calculated upward velocity in the vertical duct varies only from 6·4 to 9·2 ft/sec.

(ii) *With appliances in Use*

The addition of thermal energy to the duct air under wind conditions is equivalent to an increase in the suction at the terminal to an extent that is dependent on the relative magnitudes of the suction due to wind and that due to thermal energy. It may be shown that, for wind speeds below 20 m.p.h., the flow is determined largely by the thermal contributions, but for wind speeds of 40 m.p.h. the wind effect is the dominant factor. From these considerations, the following deductions may be made of the air velocity through the vertical duct :—

(*a*) For wind speeds up to 20 m.p.h., the duct air velocity would vary from 3 to 5 ft/sec, when no appliance is in use, and would be approximately 8 ft/sec with three water heaters in use simultaneously.

(*b*) For winds up to 40 m.p.h., the duct air velocity would have a maximum value of 10 ft/sec with or without any thermal contributions.

These results are in conformity with the recorded data.

These theoretical considerations are also applicable to distributed openings and to neutral zone inlets and in general to right-angled inlet ducts. For a system with a single ground-level opening, it is calculated that the upward velocity would be appreciably higher than for a system with two inlets, and when the ground-level opening is leeward the flow would be lower and might be downwards. The magnitudes of these velocities and the conditions under which downflow would occur are discussed in Appendices 4 and 5, together with an interpretation of the observed velocities for the conditions shown in Figure 7.

(4) DESIGN FACTORS

The essential design requirement for the system is that the concentration of carbon dioxide in the duct air should not exceed a value that would adversely influence the performance of the appliances. A number of factors influence this, and from the analysis in Appendix 5 an assessment may be made of their significance.

(a) Usage of the Appliances

The concentration of carbon dioxide in the duct air is dependent on the number of appliances in use simultaneously. For the type of appliance that is in use frequently and for long periods, design must be based on the simultaneous operation of all the heaters. Where, however, appliances are operated intermittently, the number in operation at the same time is dependent on the pattern and extent of the individual usages.

In the local-authority flats at Gateshead and Islington, the peak usage of the water heaters was low and an unsuitable basis for use in design calculations for future installations, particularly as an allowance should be made for a likely increase in the standard of usage of the appliances during the period of the life of the building. In Appendix 3, a somewhat higher standard is assumed, and it is shown that the design of ducts serving up to six, 11, 16, 22 and 29 heaters should be based upon the simultaneous usage of the upper two, three, four, five and six heaters.

Hitherto, design has been based on a criterion of a 2 per cent concentration of carbon dioxide at the top of the duct, so that at entry to the top appliance it is somewhat less. Static vitiation tests have shown that the appliances will, in fact, tolerate a 2 per cent concentration of carbon dioxide in the combustion air, and the above design requirement has, therefore, incorporated an overload factor. As data are now available on the number of appliances likely to be in use together, this overload factor is no longer necessary and a 2 per cent concentration of carbon dioxide at the entry to the top appliance is, therefore, justified.

(b) Wind Effects

Observations, supported by theoretical considerations, show that, except for single-limb inlets, the effect of winds is to increase the upward flow rate in the duct. The concentration of carbon dioxide will, therefore, be a maximum under wind-free conditions, and design must be based on this condition. As shown in Appendix 4, the system will tolerate adverse pressure conditions to a limited extent, so that the terminal position is not critical.

For systems with single-limb inlets, the wind effect is dependent on the degree of exposure of the inlet. In view of the large variations in exposure that are possible, and of the limited experience currently available, the design of such systems requires individual consideration.

(c) Extraneous Thermal Effects

Heat transferred through the duct wall and from pilot flames serves useful purposes in that the heat gained by the duct air reduces the likelihood of condensation and of freezing in the case of water heaters. However, these thermal effects do not materially influence the design of the system, for, although the flow rate due to these effects is significant when one or two appliances are in use, the flow rate is determined almost entirely by the thermal energy from the appliances when the larger numbers normally required by design are considered.

(d) Leakage Effects

For systems in which the air supply to the vertical duct is taken from a neutral point, air leakages through small openings will be into the duct and will increase the flow rate by an amount that increases as the number of heaters in use increases. The concentration of carbon dioxide in the duct

air is, therefore, a maximum for a perfectly room-sealed system, and design must be based on this assumption. The effect of leakage on a single-inlet system is considered in Appendix 4(*e*).

(E) Recommended Design Practice

The above recommendations have been used to calculate Table 27, with the additional assumptions that :

(i) the flue outlet of the top appliance is at least 4 ft below the terminal,

(ii) the appliance efficiencies are 80 per cent ; and

(iii) the inlet flow resistance is 1·5 velocity heads.

Table 27 gives the duct areas that may be used in future installations, together with the sizes required originally. For the calculation of the required duct area for drying-cabinets, one of the design criteria[10] is the ratio of the volume flow through the appliance and through the duct. Laboratory observations have shown that this ratio may be increased from 0·4 to 0·6, leading to a reduction in duct areas. Whereas previously the minimum recommended duct area was 1 sq. ft, in some cases a smaller area will suffice.

Table 27.—*Revised and Original Duct Areas.*

Duct Height (ft)	Number of Dwellings Served	Cross Sectional Area of Duct (sq. ft)					
		Instantaneous Water Heaters (100,000 B.t.u./hr)		Circulators and Space Heaters (30,000 B.t.u./hr)		Instantaneous Water Heaters and Space Heaters	
		Revised	Original	Revised	Original	Revised	Original
1	2	3	4	5	6	7	8
55	6	0·4	0·7	0·4	0·5	0·7	1·1
100	11	0·7	1·2	0·7	0·8	1·2	1·8
140	16	1·0	1·4	1·0	1·1	1·6	2·2
190	22	1·3	1·8	1·4	1·4	2·1	2·8

For a 100-ft high duct serving 22 instantaneous water heaters, the revised area is 1·2 sq. ft; the original recommendation was 2·2 sq. ft.

(F) Future Design Trends

The duct system must be designed to ensure that the degree of carbon dioxide vitiation of the air entering the appliances is not excessive and that the velocity and temperature of the air flow in the duct do not adversely affect the performance of the appliances. A further study of appliance design is required in order to increase their tolerance to the conditions arising in the duct, and, as knowledge and experience grow, it may be possible, for the duct dimensions to be reduced and it may be possible for the appliances to be sited remote from the duct and thus provide greater freedom in planning. As more data become available on overlap times of appliances used intermittently, further reductions may be possible.

The vertical section of the duct is of simple form, and the terminal location, apart from one particular inlet arrangement, is not critical. Any future simplification would thus seem to be largely confined to the air inlet arrangement. The incorporation of a satisfactory air inlet does not present any difficulties in most plans, but, in special cases where a neutral point at the base of the vertical duct cannot be readily achieved, some simplification may now be possible. As experience and understanding of the system increase, it might be possible to relax still further the conditions under which a single inlet may be used, while in other cases a common inlet arrangement may be possible to serve more than one vertical duct.

(5) FIELD PROBLEMS AND EXPERIENCES

Since the first paper[6] on the Se-Duct system much experience has been gained in dealing with practical problems, some envisaged and others unforeseen, that have arisen both in the construction of installations and in the design of appliances ; this experience forms the basis of this section of the paper.

(A) Ignition of Pilot Jets

Considerable difficulty was experienced in the lighting of the pilot jets of both water heaters and air heaters, in the 12-storey flats at Harlow when a large differential pressure of the order of 0·1 in. w.g. developed between the room and the duct. This caused a suction through the open lighting port sufficient to extinguish a match flame before ignition of the pilot jet could be established.

In the water heaters, this was overcome by providing a small closeable aperture of $\frac{1}{8}$ in. diameter, through which the match flame became so extended by the draught that it reached the pilot jet, and in the space heaters by enlarging the lighting port so that the match head could easily be placed close to the pilot jet. These experiences draw attention to the need to consider the provision of ignition devices that can be operated without opening the lighting port.

In drying-cabinets at the Gateshead installation, it was found necessary to fit a shield near the pilot jet to prevent reduction of the heating of the bi-metal element due to a slight draught and the consequent closing of the valve that occurred when the cabinet door was closed.

(B) Flame Stability

In the development of the Se-Duct model of one instantaneous multi-point water heater, it was found necessary to incorporate a horizontal flat plate in the path of the air entering the appliance, in order to stabilize the flames, which were excessively disturbed at high velocities of air flow in the duct. This plate, which, to be fully effective in preventing turbulence in the air flowing through the inlet spigot, must be fitted within a reasonable tolerance of the optimum position, is now a standard component of the appliance.

(C) Noise

The question whether the presence of a Se-Duct in a building would increase the transmission of sound from one dwelling to another or from outside the building into dwellings remained to be answered until blocks of flats were completed.

Tests were made aurally of sound transmitted between unfurnished rooms on adjacent floors in which water heaters and drying-cabinets were fitted to the Se-Duct. No significant transmitted sound was heard even when very loud and shrill noises were made. Furthermore, no comment has been received from tenants of occupied flats to suggest that the presence of the Se-Duct leads to any increase in noise transmission.

Noise developed by the operation of water heaters, however, presented a serious problem when a musical note of high intensity occurred on the simultaneous operation of two or more heaters on the Gateshead Se-Duct. Experiments indicated that the origin of the sound was in the burner flames and was stimulated by resonance in the combustion chambers and duct system. This phenomenon, which has not been observed with any other appliance, was entirely eliminated when the horizontal air flow stabilizing plate referred to above was fitted, and it appeared, therefore, to be associated with the character of the air stream entering the combustion chamber. However, at Crawley also the noise problem occurred, but only when all the water heaters were in use together, and then only when they were turned on in a particular order. No troubles were encountered at Islington or Harlow, but at Willesden a slight duct noise, associated with the use of a particular appliance, was attributed to a broken pilot burner and overcome by changing this. It would seem, therefore, that noise experiences, although causing no inconvenience, are not fully explained, but appear to be accounted for by minor faults in the appliance.

(D) Condensation

During the investigations on the performance of the original experimental Se-Duct[6], condensation was observed in unoperated appliances at high levels, and, occasionally, in the duct during extreme adverse climatic conditions. Calculations indicated, however, that this would not occur to a significant degree in a system built in an occupied block. Careful examination of the condition of water heaters and drying-cabinets at the Gateshead flats after 12 months' and 22 months' occupation, during which time two maintenance servicings had been carried out, showed that no condensation of any significance, and no deterioration of the duct had occurred. The condition of all the appliances was very good, and better than that of similar appliances of conventional design used to a similar extent. Because of this, the period between maintenance visits has been extended from eight months to 12 months.

(E) Planning Problems

(i) *Air Inlets*

In the majority of installations constructed and planned, two horizontal limbs have been incorporated, the inlets being flush in the wall of the building or in brick boxes a short distance from the buildings, and in most cases at least 2 ft above ground level. No instance is known of foreign matter entering the inlet grille and thereby causing restriction of the ducts.

In many plans, it has been necessary for the horizontal ducts to take a somewhat devious route in order to pass service ducts, lift shafts, load-bearing beams, and similar obstructions.

Efforts to reduce horizontal ducts to a minimum led to the use, as the position for a single inlet, of a space within the building in which the pressure due to winds would approximate to the mean of the pressures developed around the building at ground level. Many installations have been constructed and planned utilizing a " neutral " area of this type, which required the free access of air from opposite aspects of the building ; where such access has not been available in the building plan, a duct through an enclosing side has been provided. Examples of these two arrangements are shown in the plans Figures 6(c) and 11. Plans are under consideration in which the well-ventilated space below a ground floor is to be used as the neutral zone. In a number of buildings in which the ground floor is used for purposes other than habitation, such as store rooms, and air can circulate freely, no horizontal ducts have been necessary ; the inlet to the vertical duct has been simply an aperture in the ceiling. In such arrangements, ventilating openings have been provided in the outer walls of the ground floor. An example of this arrangement is seen in Figure 12, which shows a 10-storey block of 160 flats in Cholet, France, where appliances fitted to the Se-Duct supply space heating and hot water. It is of interest to note that one Se-Duct of this installation is fully instrumented, by the staff of Gaz de France, to provide data similar to those obtained at Gateshead, and, in addition, continuous records of the wind speed and direction at the top of the duct.

In Australia, use is being made of well-ventilated service ducts of 8 ft × 4 ft cross-section for the fitting of Se-Duct type water heating appliances, and in some of these the inlet is an aperture in the ground floor ceiling. Figure 13 shows an internal view of a 120 ft high service duct with the appliance spigots protruding through the walls. In such installations, the problem of sizing of the duct does not, of course, arise, as the aim of design considerations is to specify the minimum size that will ensure satisfactory performance of the system.

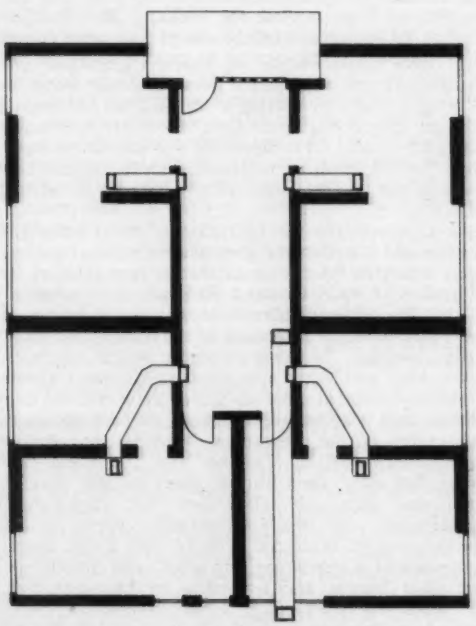


FIGURE 11.—*Se-Duct ; Improvized Neutral Zone.*

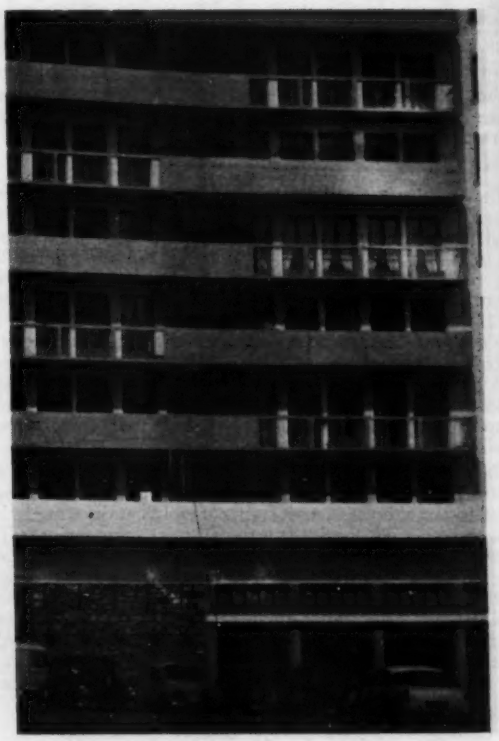


FIGURE 12.—*Cholet (France): Ventilating Openings to Ground Floor.*

(ii) *Siting of the Vertical Duct*

Advantageous siting of the SE-duct within the plan of a dwelling is dependent on the service to be provided by the appliances, and location of the SE-duct to enable appliances to provide an efficient service and convenience of operation to the occupier has not presented any insurmountable difficulties. Minimizing the length of draw-off pipes to kitchen sinks in the case of water heaters, and of air ducts from air heaters has, in most plans, dominated selection of the position of the Se-Duct.

The latitude permissible with the water heater has been extended by a better appreciation of the smallness of the delay in the delivery of hot water and of the loss of temperature that results from the increase in length of the pipe run from the heater. Examples of these effects for a flow of 1·5 gal/min. are shown in Table 28.

TABLE 28.—*Effect of Length of Copper Draw-off pipe on Temperature and Delay in Delivery*

Supply Temperature, 55°F ; Temperature Rise in Heater, 80°F				
Length of Draw-off Ft	Time After Opening Tap (sec.)		Temperature (°F)	
	½" pipe	¾" pipe	½" pipe	¾" pipe
1	2	3	4	5
0	30	30	135	135
10	35	40	134·6	134
20	40	50	134·3	134
30	45	60	134	133·5

(f) Terminations

As anticipated from the work on the experimental Se-Duct successful performance of the system has been found less critical to the location of the terminal than is the case with other flue systems. The records of the Gateshead installation showed that, although inversion conditions due to high atmospheric temperatures and winds likely to cause high static pressures around the terminal occurred, no downflow of any significance was observed in the duct and no appliances were adversely affected. Terminals are situated in many cases in close proximity to obstructions such as parapets and tall roof structures without causing unsatisfactory performance. At Gateshead, the apertures of the terminals are partly below parapet level, and many are within 2 ft of the parapet ; two are 7 ft from the 14 ft high wall of the tank room. Satisfactory performance of the installations, with termination positions that would be regarded as certain to give rise to troublesome downdraught in conventional flues, confirm the conclusion

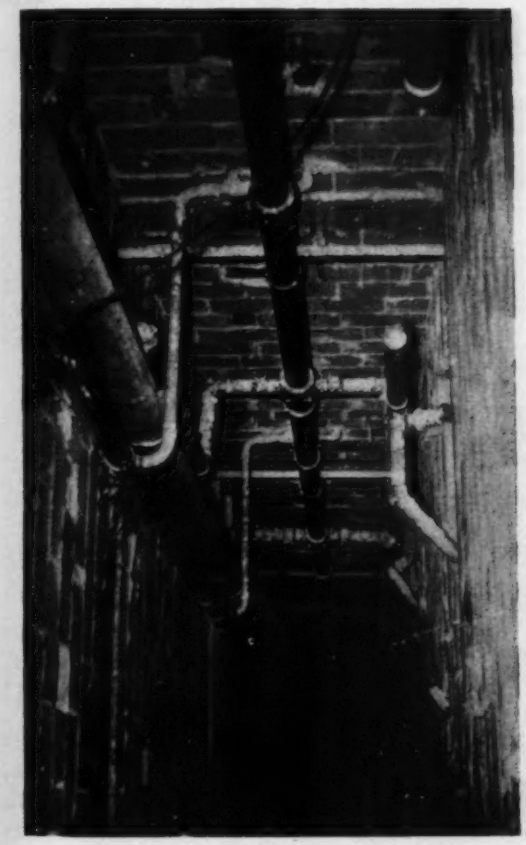


FIGURE 13.—*Australia: Use of Ventilated Service Ducts as Se-Ducts.*

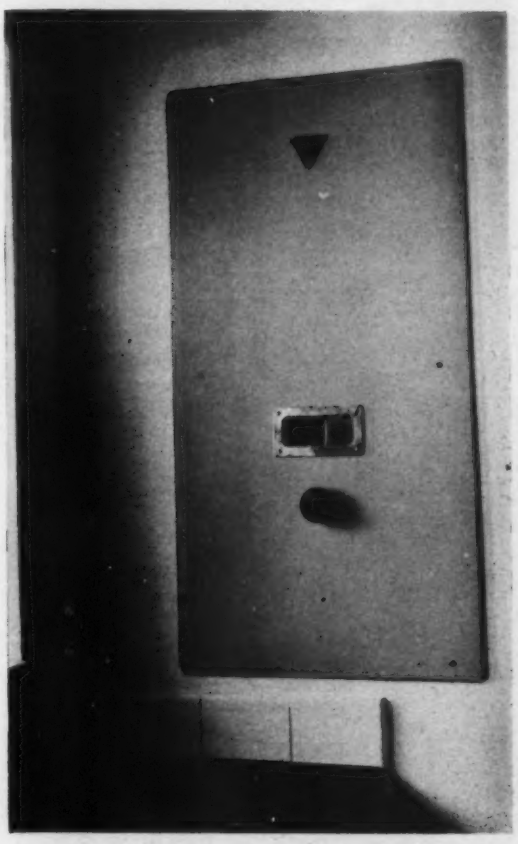


FIGURE 14.—*Crawley: Water Heater on Se-Duct Fitted in Cavity.*

drawn from observations on the experimental installation : that for successful performance the system is not critically dependent on the design or location of the termination. Nevertheless, locations where a high static pressure would at times inevitably develop must be regarded as unsuitable, and such positions have been avoided in all schemes ; in some by simply off-setting the top 4 ft of the duct at 45° to provide 2 ft clearance from the local obstruction.

(G) Location of Appliances

In many plans, full advantage has been taken of the fact that it is unnecessary to provide free access of air from the room to the heater for combustion in the sealed type of appliance ; in consequence, in many installations appliances are concealed within cupboards or panelled recesses. A view of one installation of this type is shown in Figure 14. It is considered advisable that small apertures should be provided in every compartment housing a sealed appliance, as is conventional with gas meters, for instance, for preventing the development of a concentration of gas in the event of leakage.

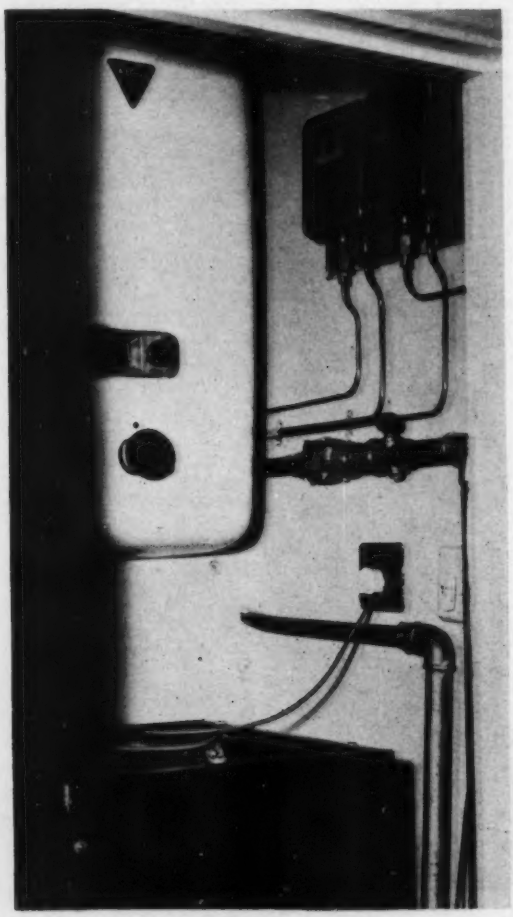


FIGURE 15.—*Harlow: Instantaneous Water Heater and Air Heater in Cupboard.*

Many compact arrangements of two appliances have been devised, including an instantaneous water heater fitted above an air heater within a cupboard (Figure 15). Further compactness has been achieved in a design in which a circulator-type water heater and an air heater are built into one unit, but operate independently, the air and products spigots being combined so that only two apertures in the Se-Duct are required for connexion. (Figure 16.)

A scheme in which an air heater for space heating could be used for heating a drying-cabinet also vented into the Se-Duct well, was devised. The advantage of using one appliance for both services, however, is considered to be more than offset by the need to provide an automatically operated closure plate in the duct between the heater and the cabinet, to seal the Se-Duct from the air heater when not in use for drying, by the comparatively low efficiency of drying by this method, and by the loss of the space heating service for the period during which clothes drying is carried out. It is, therefore, considered that, in general, drying facilities are provided more efficiently and at less cost by using an independently heated drying cabinet.

(H) Installation of Appliances

Since the early installations, in which some difficulties were encountered in the cutting of holes in the duct walls for accommodating the appliance spigots, improved methods

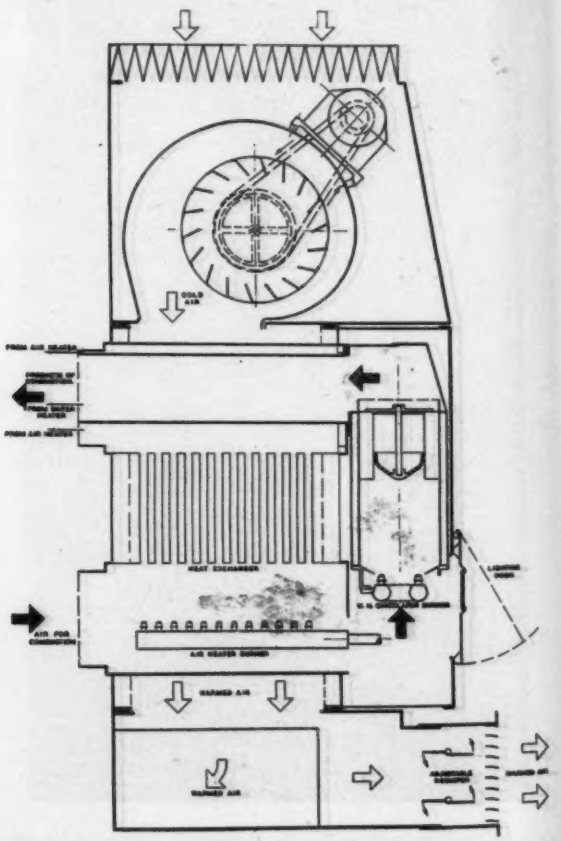


FIGURE 16.—*Combined Circulator and Air Heater.*

of cutting holes *in situ*, and blocks cast with suitable holes, have both become available.

Figures 17 and 18 show two types of tool capable of cutting rectangular and circular holes respectively, with comparative ease in a matter of 4 min. The tool illustrated in Figure 17 employs a carborundum disc, effective for 24 rectangular holes, which in a Newcastle Corporation block of 279 flats were cut by the operator in a single session of 3 hr.

The employment of blocks with pre-formed holes necessitates a specification of the appliance to be fitted and precise details of the building relevant to the location of the appliances on the duct being available at an early stage in the planning, and particular care by building operatives during erection of the duct. This method, illustrated in Figure 19, of providing the apertures for appliances has the merit of requiring no electric power on the building site, as is necessary for cutting holes *in situ*, and has now been used successfully in a large number of installations.

Breeze block, brick and hollow " pot " slab have all been used for cladding the duct; with the latter two claddings, recesses for accommodating appliances must be formed during construction, and only the former two are suitable for appliances that are anchored to the cladding for supporting the appliance or for effecting a sealed connexion. The formation of a recess in hollow pot cladding for a water heater and the channels for concealing the gas and water pipes to it are seen in Figure 20.

Acceptance of the Se-Duct as a flue system conforming with the model and local by-laws relating to flues and with regulations for the prevention of fire in dwellings has been general and no serious difficulty has been met in obtaining a " waiver " to a local by-law where this has been considered necessary.

(j) The Design and Material of the Se-duct Units

The unit system of construction of the duct has proved very satisfactory, but, nevertheless, consideration has been given to alternative methods and materials. The merits of small units—adaptability and hence standardization, prefabrication, control of size, ease of handling, and the suitability of the material—durability, control of dimensions, acceptance as a traditional building material, resistance to fire, cost, robustness and ease of formation of holes have been weighed against those of other forms of ducting, and it is considered that the balance is well in favour of the present design.

The variety in the schemes for which plans of Se-Duct installations have been proposed has thrown up a large number of practical problems of construction, which have been solved either by the introduction of units additional to the range initially designed or by modification of some of the original units: for instance, the base T block is now square in order to allow connexion of the horizontal duct on either the short or long side of the vertical duct. The simple unit is now available with side extensions that can rest on the floor, so that the vertical duct is supported at each floor level instead of entirely on the base T block. These bearer extensions run along only half the side of the block, so that pipes can be run within the cladding of the duct. Angular units with a 135° offtake for the construction of deviating ducts have also become standard.

FIGURE 17.—*Tool for Cutting Rectangular Holes in Se-Ducts.*

FIGURE 18.—*Tool for Cutting Circular Holes in Se-Ducts.*

FIGURE 19.—*Dulwich: Precast Holes for Connexion of Appliances.*

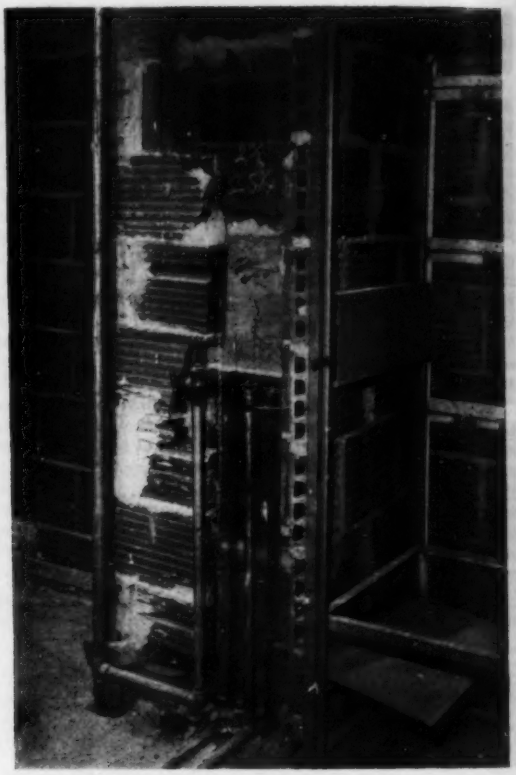


FIGURE 20.—*Eltham: Hollow Pot Cladding.*

(K) EXPLOSION HAZARD WITHIN THE SYSTEM

To verify the view held, on the basis of calculation, that an explosion could not occur in the duct as a result of the discharge of unburnt gas into it, experiments were carried out on the original laboratory installation.[5] Numerous trials were carried out in which gas was discharged into the duct at rates of up to 400,000 B.t.u./hr (i.e., from four water heaters simultaneously), and flames and incandescent filaments were applied either in the combustion chamber of an appliance discharging gas or in the duct at the outlet spigot of the appliance and at various heights above it, at a period when air in the duct was initially stagnant. In no case did explosive combustion occur in the duct, although explosive ignition of the mixture within the heater did occur in some instances when the flame was applied in the combustion chamber. The most violent effect in the duct occurred in such instances and was in the nature of a gust in the duct, which had no effect on the mechanical soundness either of the appliances or of the structure.

(L) TEST PERFORMANCE REQUIREMENTS AND RANGE OF SE-DUCT APPLIANCES

The range of appliances, as anticipated, has increased[11] since the introduction of the system, and the following appliances have been tested for Gas Council approval: one instantaneous water heater, six circulators for hot water storage systems and space heating, two convector space heaters, one clothes drying-cabinet and six warm air heaters. Other appliances are known to be under development. The proposed test schedule for these appliances include the requirements for conventional appliances as laid down in B.S.1250, and the following in addition :—

(i) The carbon monoxide : carbon dioxide ratio shall not exceed 0·02, and the flames of the main burner and of the pilot burner shall remain stable when

(*a*) vitiation, by product of combustion, of air entering the appliance corresponds to 2·5 per cent of carbon dioxide; and

(*b*) air flow up the duct to which the appliance is attached has a velocity of up to 15 ft/sec.

(ii) The burner and pilot flames shall not be extinguished with a downflow in the duct at rates from zero to 1 ft/sec.

(iii) The thermal efficiency when the upward flow is 10 ft/sec shall be not less than 0·9 of the value obtained when the appliance is free-standing.

These additional requirements have been based on experience of the conditions to which appliances are subjected in installations, and have been satisfied, without undue difficulty, by the appliances so far tested. Consideration is now being given to include these in B.S.1250.

The need for a Se-Duct type of convector gas fire has been evident from a number of proposed schemes. Development work is well advanced on two designs,[12] district trials with prototypes have commenced, and it is anticipated that fires with an overall efficiency of about 75 per cent will be available commercially by 1961.

(*To be concluded.*)

Christmas Lectures for Young People

Every Christmas, a series of Lectures for Young People, on subjects related to gas engineering, is arranged at various centres by the Christmas Lecture Panel of the Gas Education Committee of The Institution of Gas Engineers, with the assistance of its District Sections and affiliated Associations. Details of some of the lectures given in the Christmas vacation 1960-61 are given below ; others will be reported in later issues of this *Journal*.

The Institution gratefully acknowledges the time and energy generously devoted by the lecturers and their assistants and the ready co-operation of its District Sections and affiliated Associations, the Area Gas Boards, the Universities and the Technical Colleges that provided lecture theatres, and all who helped to make the lectures a success.

Edinburgh

A lecture on " Harnessing the Flame " was given by Dr. F. J. Eaton, B.Sc. (Deputy Manager, Watson House, London), in the Heriot-Watt College, Edinburgh, on Monday, 19th December, 1960, under the auspices of The Scottish Association of Gas Managers. About 250 schoolchildren were welcomed by Mr. D. Beavis (President of the Association) and Dr. H. B. Nisbet (Principal of the College). The audience was entertained by the demonstrations of " performing " and " singing " flames, which were among about 30 experiments that Dr. Eaton included in his lecture and these attracted favourable notices in the Scottish daily press.

Liverpool and Manchester

Under the auspices of the Manchester and District Section of The Institution of Gas Engineers, Dr. B. H. Holland, M.Sc. (Physical Chemist, North Western Gas Board) delivered a lecture, entitled " Flame and Combustion ", twice to Lancashire audiences.

On Wednesday, 28th December, 1960, in the Dalton Theatre of the University of Manchester, under the chairmanship of Mr. W. B. Harrison (General Manager, Central Lancashire Group), Dr. Holland addressed an audience of 220 young people who followed the lecture and demonstrations keenly.

On Wednesday, 4th January, 1961, in the Muspratt Theatre at the Donnan Laboratories of the University of Liverpool, Dr. Holland repeated the lecture before an audience of 240. On this occasion, the Chairman was Mr. J. Castle, B.Sc. (Honorary Secretary of the District Section).

London

A lecture on " The Production of Fuel Gases " was given by Mr. C. H. Lewis, M.Sc. (Fulham Research Laboratories, North Thames Gas Board), in the Imperial College of Science and Technology, London, on Tuesday, 3rd January, 1961, under the auspices of The Institution of Gas Engineers. The lecturer was introduced by Mr. H. S. Cheetham (President of the Institution), and a vote of thanks was proposed by Mr. R. N. Le Fevre, M.B.E. (Chairman of the Christmas Lecture Panel).

Mr. Lewis described how combustible gases were produced from a wide variety of materials. A team of assistants operated a series of scaled-down demonstrations of these methods, and the exploitation of natural gas resources was illustrated by a coloured cartoon film. An audience of 194 schoolchildren followed the lecture with rapt attention and afterwards gathered around the lecture-table to ask questions.

Middlesbrough

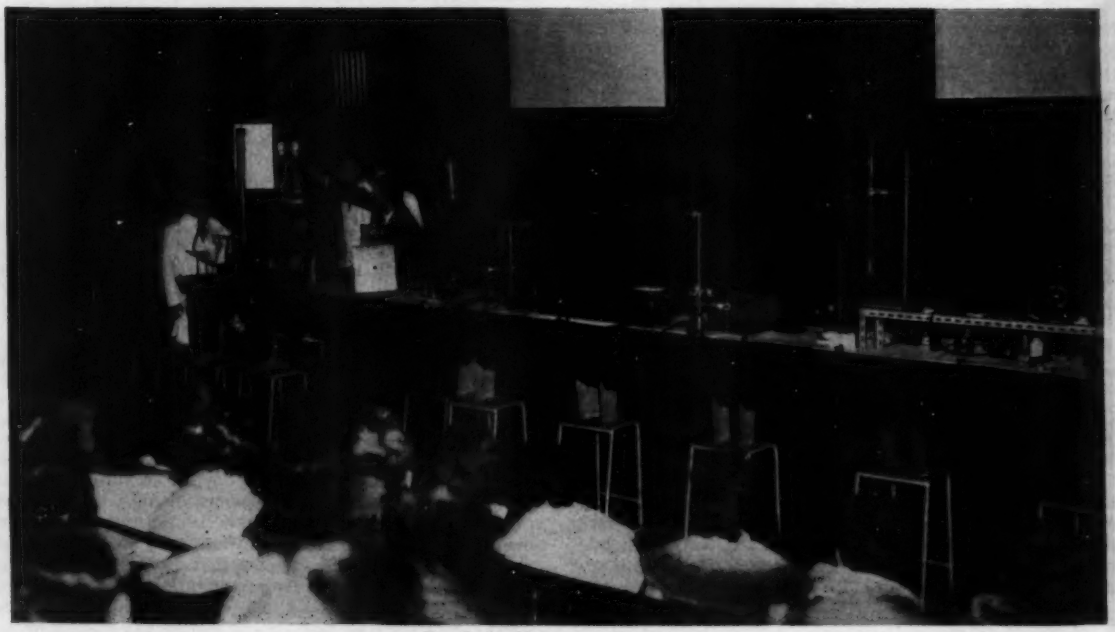
In the Constantine Technical College, Middlesbrough, on Wednesday, 14th December, 1960, under the auspices of the North of England Section of The Institution of Gas Engineers, Mr. J. A. Prigg, B.Sc. (Watson House, London), lectured on " Harnessing the Flame ". The Chairman was Mr. H. Buckley (Divisional General Manager, Tees-side Division, Northern Gas Board). An audience of about 140 senior schoolchildren and college students received the lecture with enthusiasm.

Oxford

" Flame " was the subject of a lecture that Mr. W. F. Thorne, B.Sc., A.R.I.C. (Chief Chemist, Southern Gas Board), delivered to six audiences of schoolchildren in the Oxford College of Technology on 2nd, 3rd and 4th January, 1961. The lecture was given under the auspices of the London and Southern Section of The Institution of Gas Engineers, whose Chairman (Mr. J. A. Hepworth, B.Sc.) presided at one of the sessions. Dr. A. E. Haffner, B.Sc. (Vice-President of The Institution of Gas Engineers) officiated on another occasion. Other senior officers of the Southern Gas Board (Mr. S. C. Bentley, Mr. H. G. Broadbridge and Mr. G. D. Phillips, M.B.E.) also acted as Chairmen.

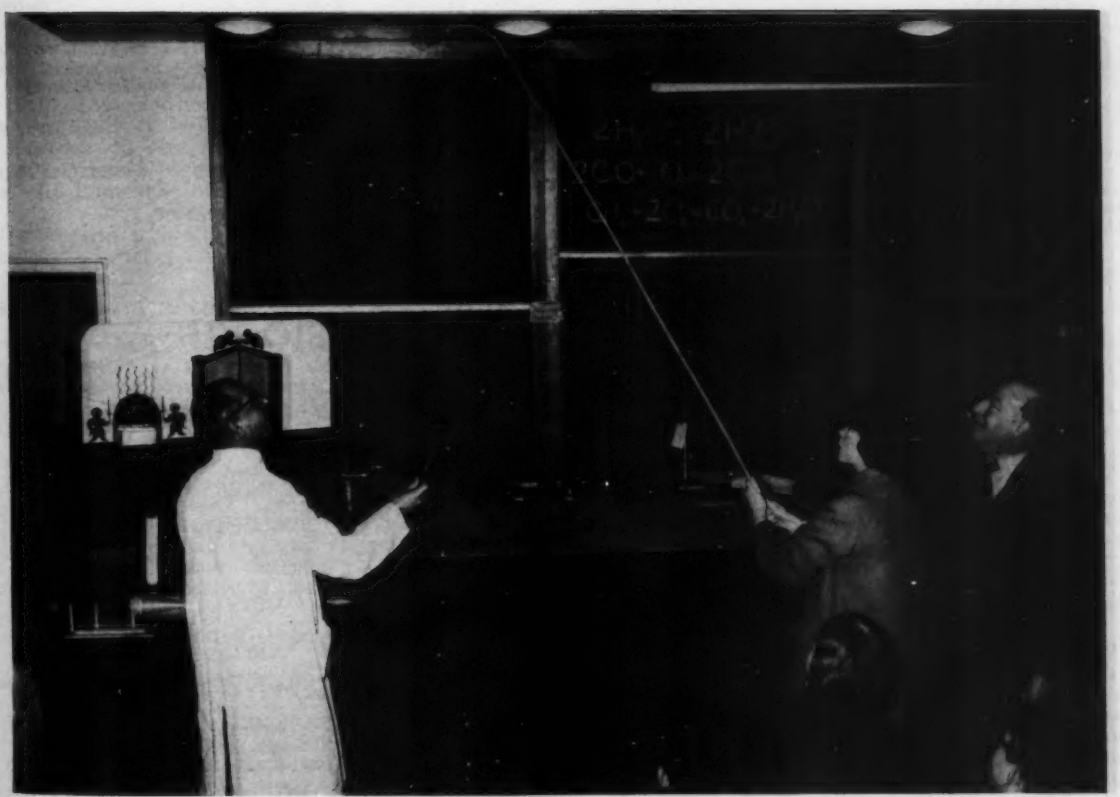
The audiences were drawn from schools in Berkshire and Oxfordshire and followed the lecture and accompanying demonstrations with close attention. In the photograph on p. 137, the lecturer and his assistant (Mr. H. L. G. Boot, B.Sc., Chemist-in-Charge, Southern Gas Board Central Laboratory, Poole) watch a schoolgirl lighting a gas-filled bubble containing a hydrogen/oxygen mixture. The ear-splitting bang produced was evidence of the explosive speed of a flame in a mixture of suitable composition. In another demonstration, the lecturer showed how, in a weaker gas mixture, a flame would travel at a few miles per hour from one end to the other of a long glass tube.

Dr. F. J. Eaton in Edinburgh



Dr. B. H. Holland in Lancashire

Mr. C. H. Lewis, M.Sc., in London



Mr. W. F. Thorne, B.Sc., in Oxford

Photo: Southern Gas Board.

Christmas Lecture: Mr. J. A. Prigg, B.Sc., in Middlesbrough

Nomination of Ordinary Members of Council

Corporate Members of the Institution are reminded of the following procedure, set out in By-law 50, for the submission of nominations for the election of Ordinary Members of Council :—

> " It shall be open for any ten Corporate Members to propose any other Member or Associate Member as an Ordinary Member of Council, the consent in writing of such Member or Associate Member having been first obtained. If such proposal be duly made in writing and delivered to the Secretary, together with the written consent of the Member or Associate Member proposed, not later than two months previously to the Annual General Meeting, the Council shall accept the nomination and add the name of the person so proposed to the balloting list. No Member or Associate Member shall join in more than one such nomination in the same year ".

A Form of Proposal may be obtained from the Secretary of the Institution, to whom it should be returned, after completion, not later than 31st March, 1961.

Joint Groups of Professional Engineers Overseas

The Institutions of Civil, of Mechanical and of Electrical Engineers, acting jointly, have formed, in various parts of the world, Joint Groups, which provide meeting and other facilities for local members of these three Institutions. Joint Groups are at present operating in Aden, Argentina, British Guiana, Ghana, Gibraltar, Hong Kong, Jamaica, Middle East, Singapore/Malaya, Trinidad and Tobago, and West Africa.

Recently, proposals have been made to extend the facilities of the Joint Groups to local members of certain other societies, including those that are members of the Commonwealth Engineering Conference, the Conference of Engineering Societies of Western Europe and the United States, and a number of British societies operating in associated fields. Among the latter is included The Institution of Gas Engineers.

The decision as to whether it will broaden its membership and operate under the proposed extended scheme is left to each individual Joint Group. So far, the Gibraltar and the Trinidad and Tobago Joint Groups have decided to extend their membership as suggested, and any members of The Institution of Gas Engineers residing in these areas are invited to communicate with the respective Honorary Secretaries :—

Gibraltar :	Major D. S. Evans, R.E.M.E., A.M.I.Mech.E., 51, Europa Road, Gibraltar.
Trinidad and Tobago :	Mr. D. P. J. Holbrook, B.Sc. (Eng.), A.M.I.E.E., c/o Trinidad Oilfield Service, Limited, P.O. Box 69, San Fernando, Trinidad, B.W.I.

Particulars will be given in the *Journal* of any further Joint Groups that decide to extend their membership.

District Sections and Affiliated Associations

(a) Notes of Meetings

DISTRICT SECTIONS

North of England Section

(*a*) A general meeting of the Section was held at the Washington Works of Newall's Insulation Company, Co. Durham, on 3rd November, 1960. The Chairman and members were received at the works by Mr. R. S. Robinson (Technical Division Manager) and were then taken on a short tour of inspection of sections of the works connected with the manufacture of heat insulation.

After the works visit, members assembled in the staff canteen for the business meeting. Mr. G. Alderson (a director of the Company) extended a warm welcome to members of the Section on behalf of the Chairman of Newall's Insulation Company (Mr. Clogg) and his co-directors, and expressed the hope that the visit would prove to be interesting and informative to all present.

Mr. B. Richardson (Chairman of the Section) replied and introduced Mr. E. G. Cawte and Mr. G. Jolley, both members of the staff of Newall's Insulation Company, and called upon them to present their papers, *viz.*, "Thermal Insulation—Materials and General Principles", by Mr. E. G. Cawte, and "Applications of Thermal Insulation in the Gas Industry", by Mr. G. Jolley.

Several members took part in the interesting discussion on the papers, which was followed by a vote of thanks to the authors proposed by the Chairman and passed with acclamation.

Members were then entertained to tea, during which the Chairman proposed a vote of thanks to the directors and staff of Newall's Insulation Company for the facilities and refreshments provided, which had ensured a very successful meeting. Mr. G. Alderson replied on behalf of the Company.

(*b*) There was a large attendance of members and guests at a meeting of the Section held in the Distribution Centre of the Northern Gas Board, Newcastle-upon-Tyne, on 1st December, 1960, to hear Mr. W. R. Garrett (Constructional and Consultant Engineer, Northern Gas Board) present his paper entitled "Engineering Comparisons of Two Recently Reconstructed Gas Works".

The paper was illustrated by a series of lantern slides showing various stages of the reconstruction of the two works.

Discussion on the paper was opened by Mr. K. W. Francombe (Darlington), and further contributions were made by Mr. H. Waiton (Howdon), Mr. J. T. Lewis (Sunderland), Mr. N. Henderson (Chester-le-Street), Mr. W. Sutcliffe (Newcastle), Mr. W. O. Kirkwood (Sunderland), and Mr. J. E. McManus (Blyth).

A vote of thanks was proposed by Mr. K. W. Francombe (Junior Vice-Chairman).

Mr. B. Richardson (Chairman of the Section) proposed a vote of thanks to the Northern Gas Board and to Mr. W. Sutcliffe (General Manager, Tyneside Division) for the facilities and refreshments provided.

South Western Section

A general meeting of the Section, held at Bristol on 8th December, 1960, was attended by some 60 members and guests. It was followed by luncheon at the Royal Hotel, Bristol, and a visit to Bristol-Siddeley Engines, Limited, at Filton.

The Chairman of the Section (Mr. T. W. Jackson), welcomed the guests from Bristol-Siddeley Engines, Limited, and in thanking them for the excellent arrangements made for the visit, stated how much the members of the Section looked forward to seeing how gas was applied in the works.

He then introduced Mr. K. G. Eccleshare (Senior Industrial Gas Engineer) and Mr. C. H. Hirst (Industrial Gas Engineer), South Western Gas Board, who presented their paper entitled "Recent Industrial Gas Developments in the South West".

There followed a lively discussion, which was opened by Mr. T. H. Pardoe (Area Industrial Gas Engineer, South Western Gas Board).

The authors were congratulated on their paper by Mr. T. W. Clapham (Area Production Engineer, South Western Gas Board), who proposed the vote of thanks.

JUNIOR GAS ASSOCIATIONS

London and Southern Junior Gas Association

A general meeting of the London and Southern Junior Gas Association was held at Westminster Technical College, London, S.W.1, on 9th December, 1960, under the presidency of Mr. P. J. Savage, and was attended by over 100 members and visitors.

The President announced with regret the resignation from the service of the North Thames Gas Board of Mr. J. D. Grant, and said that, as a result, Mr. Grant would be leaving the Association. The loss to the Junior Gas Associations' movement would be serious. As well as being a valued

Council Member, Mr. Grant had also been Chairman of the British Junior Gas Associations' Joint Council. Mr. Savage expressed the good wishes of the Association to Mr. Grant for his future success.

The President then introduced Mr. B. L. J. Neal and Mr. V. Iutz, B.Sc., A.C.G.I. (North Thames Gas Board), who presented a paper entitled "The Production of 'Gloco' and the Maintenance of Its Quality".

Mr. Dawkins, in proposing the vote of thanks, said that the evening had been most successful, as shown by the intensity and value of the discussion. In his view, the paper had re-established the well worn adage that "Profits are made in the retort house".

Manchester District Junior Gas Association

An evening meeting of the Association was held in the Gas Showrooms, Manchester, on 7th December, 1960, when the President (Mr. J. A. Taylor) and about 50 members heard a paper, "Ten Years' Working for Safety", by Mr. H. G. Hall (Safety Officer, North Western Gas Board).

The paper, which was illustrated by slides, was followed by a long and interesting discussion.

A vote of thanks to Mr. Hall was proposed by Mr. W. F. Howell (Senior Vice-President), and Mr. P. Faulkner offered the thanks of the Association to Mr. A. H. Nicholson (General Manager, Manchester Group) for the facilities for the meeting and the hospitality provided.

Scottish Western Junior Gas Association

(*a*) The annual Short-paper Evening was held on 4th November, 1960, and once again a high standard was set.

Mr. R. L. Bissett (Technical Assistant, Dumbarton) presented a paper entitled "Care, Wear and Repair of Modern Carbonizing Plant".

He was followed by Mr. R. F. Connelly (Chief Chemist, Central Laboratory, Glasgow), whose subject was "The Function of the Central Laboratory".

Both papers were followed by a long discussion.

(*b*) The annual December Joint Meeting of the two (Eastern and Western) Scottish Junior Gas Associations was held, for the first time, in Glasgow on 3rd December, 1960. This was due to the fact that the visits to Scotland of the Junior Vice-President of The Institution of Gas Engineers alternates between Glasgow and Edinburgh in March each year.

For this meeting, the Scottish Western Junior Gas Association invited Mr. Sydney Smith, C.B.E. (Chairman, The Scottish Gas Board), to present the address. Mr. Smith chose as his subject "Organization and Management, with particular reference to The Scottish Gas Board".

Western Junior Gas Association

(*a*) Forty members of the Association and guests assembled at Swindon on 12th November, 1960, for the inaugural meeting of the 1960-61 session.

During the early afternoon, the Swindon manufacturing station of the South Western Gas Board was open for inspection, by courtesy of the Works Engineer and Manager (Mr. P. G. Whitehead). Members were able to inspect extensions to the manufacturing plant completed within the last two years, bringing the total works capacity up to 11 mill. cu. ft/day. Of particular interest were the following items of plant, which had been installed since the Association's previous visit to Swindon :—Carburetted water gas plant, purifiers and air blowers, primary flash distillate storage tanks, boosters, intermittent vertical chamber oven producers, primary flash distillate injection equipment, and modernized and extended railway sidings.

Following the tour of the works, members adjourned to the Gas Showrooms to hear Mr. A. Riley (Swindon) present his paper "Gas—On the Right Lines."

Mr. K. C. Eccleshare proposed a vote of thanks to Mr. Riley.

At the conclusion of the meeting, Mr. T. A. Nicholson (Taunton) proposed a vote of thanks to the South Western Gas Board for the facilities provided, and to Mr. A. Horsfield (District Manager) and Mr. P. G. Whitehead (Works Engineer and Manager) for the arrangements they and their staff had made.

(*b*) The second meeting of the 1960-61 session held on 3rd December, 1960, commenced with a visit to the Stapleton Road Gas Works, Bristol, where members inspected the primary flash distillate installation forming the subject of the afternoon's paper. Members were also able to inspect the liquid-purification plant, which is in course of conversion to the "Ada" process.

Following the visit, 57 members and guests assembled in Bath for the presentation and discussion of a paper by Mr. C. E. M. Stephens, Assistant Works Engineer and Manager (Production), Stapleton Road Gas Works, Bristol, entitled "A Storage Tank for Primary Flash Distillate".

Mr. Stephens presented his paper in shortened form, and illustrated the various constructional features with slides. A lively discussion followed.

A vote of thanks to the author was proposed by Mr. W. E. Beardshaw (Torquay).

(b) Abstracts and Discussions of Papers

Copies of the complete papers abstracted below are available for consultation or loan in the Library of the Institution.

DISTRICT SECTIONS

Eastern Section

"Work Study as Applied to Oxide-handling Plant on Tower Purifiers", *by D. W. Ault, B.Sc. (Eng.), M.I.Gas E., A.M.I.Mech.E. (Production Engineer, Eastern), and P. L. Henderson, A.M.I.Gas E. (Senior Works Study Officer), East Midlands Gas Board.*

Paper delivered in London on 30th November, 1960.

The paper deals primarily with the design of the oxide-handling plant for the tower purifier installation at Scunthorpe. The effect of the handling plant and general access arrangements on manning are discussed and a proposed manning derived from theoretical considerations is put forward. The authors contend that, once the type and size of a conventional oxide-purification system has been decided, design of the installation ceases to be a chemical engineering problem, but becomes one of materials handling.

On the assumption that three exposures of a batch of oxide will be used to work this up from new to 54 per cent sulphur burden, it is shown that, for 10 mill. cu. ft/day of gas containing 700 gr of sulphur, the following quantities of material have to be handled per annum :

	Tons
New material into the installation	1,700
Spent, away from the installation..	3,120
Within the installation during re-vivification	4,460

Since the handling equipment has to be sized in order to effect a tower change within one working week to permit tower changes at fortnightly intervals with a duplicate installation, the utilization figure for the mechanical plant is low.

Oxide handling is divided into two types, " external " covering the admission of new material and discharge of fully-spent, and " internal " covering the removal and refilling of partly-spent material.

The utilization rate of the " internal " handling equipment is assessed at 23 per cent for the installed capacity of 10 mill. cu. ft/day, which figure would improve to 55 per cent on extension of the plant to its ultimate capacity of approximately 24 mill. cu. ft/day.

The figure for " external " handling is only 5·4 percentage utilization (i.e., 14 working days/year), and for this part of the equipment the authors recommend the use of portable conveyors that can be used for other works purposes during their free time, thereby improving their utilization.

The importance of careful study of operator movement on the plant is illustrated by charts and diagrams. On an installation of this type, with a vertical height to the top platform of 75 ft, operator movement in the vertical plane is the major problem. Diagrams show the importance of correct positioning of the lift in relation to the work stations of the operators.

The authors suggest that continuous purification of 20 mill. cu. ft/day can be maintained with a maximum manual labour force of two men on normal day work. In addition to effecting the necessary tower changes and oxide revivification, the two operators would have sufficient spare time available for plant and site cleaning, and oxide loading.

The paper includes six appendices and six charts and drawings.

Discussion

Mr. C. E. Mills (Derby) congratulated the authors, firstly, for the quality of the paper and its new approach to mechanical handling in purification, and, secondly, for having the courage to present a paper on what is anticipated will be achieved at Scunthorpe. He looked forward to a subsequent paper to learn if their theories had been substantiated.

Mr. Mills mentioned briefly other tower purifier plants installed in the East Midlands Gas Board area since 1950, and drew attention to the necessity for having a purging machine of adequate size to ensure that the purging time was not out of proportion to the tray-changing time.

On the time taken to empty and re-charge trays, he felt it was difficult to draw comparisons, although it appeared that the tray-handling time at Scunthorpe would show an improvement of about 35 min. over any of the existing installations in the East Midlands Gas Board area.

Mr. Mills agreed with the authors' remarks on crane hoisting speeds, but felt that an increase in speed of the travelling and traversing motors was worthy of consideration.

Mr. H. B. Bassett (Birmingham) outlined the policy pursued by the West Midlands Gas Board in the application of work study over the last four years, and expressed his satisfaction, as a work study practitioner, at seeing the use being made by technical staff of the logical critical approach of the work study officer.

Mr. Bassett felt that, admirable as method study is in itself, it may sometimes be insufficient if time values are not used in addition, and he was pleased to note that times of operation had been considered in this case. Whilst method study techniques might suggest the ideal positioning of, say, an electric lift, it might be found that an operator on incentive might prefer to use the staircase, as he found it quicker and therefore, more profitable, despite the increase in physical effort required.

Mr. G. H. Potter (Sheffield) said that, so far as he was aware, this was the first account of a new, large-scale development in the gas industry in which work study had been applied during the planning stage. He drew attention to the necessity for strict chemical control to maintain the oxide in the best possible condition as this had an important bearing on the design of the mechanical-handling plant. Experience at Sheffield had shown that rapid rotation had a very beneficial effect on oxide condition.

Mr. Potter was interested in the authors' comments on the retention of moisture in the oxide until the final exposure, during which time it should be reduced to an economic level of 8 to 10 per cent. He felt that this might be achieved by selective drying, possibly by the installation of dry heaters at the inlet to each tower. The number of exposures to reach saleable sulphur content should undoubtedly be three, and his experience at Sheffield and at Birmingham had shown that the efficiency of a tower as first taker would fall below an acceptable level after the passage of 1,000 mill. cu. ft of gas through that tower, irrespective of the rate of throughput and the sulphur content of the gas.

Mr. Hodge (Organization and Methods Officer, Eastern Gas Board) said it was encouraging to see examples of the application of the effective use of method study in connexion with oxide handling. It was interesting to note, also, the benefits that could be derived from an examination of a model, and felt that the effect on operator movement and fire-escape arrangements was particularly striking.

The benefits claimed from the exercise at Scunthorpe represented a significant achievement, and, whilst recognizing the economies made in human effort as one of the most rewarding results of work study, he asked whether any attempt had been made to represent the improvements in terms of money, as this ultimately was the gauge of success.

Mr. Hodge enquired also whether the introduction of an incentive bonus scheme was considered, or whether the small size of the labour force, coupled with critical timing, made such a scheme unnecessary.

Mr. W. E. Dobson (Birmingham) thought that as many members of the engineering staff as possible should receive some training in method study.

He asked if the crane driver and slinger were paid an incentive bonus, and what was their performance. From the tower-changing programme contained in the paper, it appeared that the team was available for other work for five days in each two-week cycle. This appeared to be a high proportion of the team's time, and how was this usefully occupied.

Experience in the Birmingham Division on the retention of moisture in oxide had not had the same success as was apparent in the installations of the East Midlands Gas Board.

Mr. Dobson was surprised at the provision included for oxide blending and suggested that this could have been excluded, particularly with rapid rotation and three foulings.

Mr. L. F. Garner (St. Albans) noted that the time required for changing a tower at Scunthorpe is comparable with that at St. Albans, but beyond that point the advantage was lost, in the absence of mechanical discharging, in the time required to dig the oxide out of the trays. Even so, it appeared from the charts that the time allowed for taking out the grids and cleaning out the trays at Scunthorpe was generous. Mr. Garner suggested that it was quite possible for the inlet heaters on tower purifiers to serve as efficient coolers. Controlling the temperature and moisture distribution in this way could have the same effect as that achieved by rapid rotation with an automatic operator. In this connexion, it would be interesting to learn the cost of the additional equipment necessary for automatic operation of the control valves.

Mr. G. J. Middleton (Sheffield) felt that the authors had clearly proved a case for keeping the mechanical oxide-handling plant on tower purifiers as simple as possible, and suggested that it could be made even simpler by obviating the interruption to the continuous oxide flow occasioned by the buffer hopper. Could not blending be carried out on the stocking area by mechanical shovel, as already pointed out by another contributor to the discussion? he asked. He asked also if the application of work study had shown whether there is any advantage to be gained from speeding-up the mechanical oxide discharge, or whether this is sufficiently rapid in operation already, particularly in regard to a two-stream installation of tower purifiers.

Mr. Bernard Clarke, M.B.E., J.P. (Lincoln), said he was gratified to have this opportunity of paying tribute to an excellent paper. Due to the availability of coke oven gas, an opportunity was presented to apply work study to a unique capital development that needed the most careful consideration because of alternatives and the introduction of new techniques, and all had to be accomplished within a very tight time schedule. There was the need to accumulate accurate information, and how meticulously this was done could be appreciated. Research into the operation of existing plant belonging to the Board, the facility of inspection of the Monkton plant of the National Coal Board, and the co-operation and knowledge afforded by the various contractors all formed the basis of this study, which was a most worthy contribution, and the Section was indebted to the authors for delivering in such a concise manner a record of their labours.

Authors' Replies

Mr. D. W. Ault replied as follows :—Mr. Bassett's point that staircases in retort houses are frequently speedier than lifts emphasizes the importance of surveying the whole scheme and not considering individual items of plant in isolation.

Mr. Potter's views on the difficulty of drying out the oxide is interesting. Although individual tower heaters have not been fitted at Scunthorpe, provision has been made, mainly on Mr. Potter's advice, for them to be fitted in the future should this become necessary. Although four exposures were considered, Appendix 5 shows that three exposures fit in nicely at Scunthorpe and will allow efficient operation of the handling plant if the installation were duplicated. With three exposures, the quantity of gas handled by each tower per exposure would be in the region of 700 mill. cu. ft, which is within the limit mentioned by Mr. Potter.

It is difficult to give an accurate assessment of the monetary savings, as requested by Mr. Hodge, since the original Scunthorpe scheme has never been priced. It is, however, estimated that the saving in capital cost on the installation by the use of portable conveyors for the external handling plant instead of fixed conveyors should be in the region of £5,000 to £7,000, the saving being mainly due to omission of elevator pits and foundation work. Although one cannot be dogmatic on the point it is almost certain that, on duplication of the installation, three operators would have been required on the original scheme even if not on the installation as it stands. Hence, the introduction of method study has reduced the labour element of purification costs, probably by 33 per cent.

The authors are very much against the use of any incentive scheme for emptying towers, in view of the extensive damage that could be done, particularly by mal-operation of the crane.

Until such time as the installation might be duplicated, the team of two on the purifiers will be available for other work for roughly 50 per cent of their time, as pointed out by Mr. Dobson. This is unavoidable if provision is to be made for duplication, and the intention is that they should be utilized for other yard duties in their free time.

Although a number of engineers work purifiers without blending oxide, there are many who utilize blending and the authors feel that it would be unfair to engineers who might have to operate the Scunthorpe plant in the future not to allow them freedom of choice in this matter. As it stands, the plant can be operated efficiently with or without blending.

Replying to Mr. Garner, it would be misleading if one endeavoured to give the precise cost of the automatic valve operating gear, since there are several methods of doing this and the one utilized at Scunthorpe might not necessarily be applicable to an existing installation. It should be borne in mind, as pointed out in the paper, that the automatic operator, if correctly installed, in addition to providing for rapid rotation does, in fact, provide for foolproof operation of the valves, and this is probably its more important feature.

The authors have given serious thought to Mr. Middleton's advocacy of blending outside the installation. Although operating experience at Scunthorpe is not yet available to prove the point, we are convinced that the arrangements for blending within the installation, which closely follows that already installed at the Board's Neepsend Works, are more economic and provide more accurate control over blending than any carried out external to the plant.

Mr. Henderson replied to the discussion as follows :—

On the question of crane speeds, raised by Mr. Mills, it is agreed that the additional capital and running costs incurred by increasing the hoisting speed are not worth the time saved, particularly as the full benefits of increased speed are not reflected in reduced hoisting time, such activities as hooking-on, positioning, *etc.*, remaining unaltered.

The effect of increased travel and traverse motor speeds was not considered in isolation, the figures for percentage reduction in time quoted in the paper being estimated as a result of doubling all three motor speeds. Whilst increased travel and traverse speeds would have some small effect when changing the trays in the towers most remote from the stocking frame, it must be remembered that much of the crane work is connected with changing the oxide in the trays, when all movement takes place within the area of the stocking tower, stocking frame, discharger and turntable, and is not related to the tower from which the oxide has been removed. Because of this limited area of movement, the travelling speed of 100 ft/min. and the traversing speed of 50 ft/min. is considered adequate for the Scunthorpe installation.

Incentive bonuses, a subject raised by Mr. Bassett, Mr. Hodge and Mr. Dobson, was not considered, as it was felt that method study alone in this instance could bring substantial economies. As suggested by Mr. Hodge, little would be gained financially by the introduction of a bonus scheme for two men, and the amount of control over their work exercised by the mechanical discharger, crane and conveyors leaves only a small margin for the exercise of their individual efforts in the remaining manual operations.

On Mr. Bassett's point concerning the use, by operators on incentive, of staircases in preference to lifts, even though the latter have been positioned with the best of intentions, it is agreed that this may arise when financial reward is the motivating factor.

On the Scunthorpe installation, where incentive working is not contemplated, this is unlikely to be the case and it is felt that the easier method of access will be used.

Replying to Mr. Garner, the time quoted in Appendix 3 for removal and cleaning of grids is that observed on an identical plant, again where incentive working is not practised.

It is felt that the speed of the oxide discharger, mentioned by Mr. Middleton, is approximately correct. Discharging time represents approximately 28 per cent of the total time required per tray, and the increased costs of power, strength of structure and conveyor ratings would not affect the remaining 72 per cent and would reduce the total time per tower by only a small amount.

South Western Section

"Recent Industrial Gas Developments in the South West", *by K. C. Eccleshare, A.M.I.Gas E., M.Inst.F., and C. H. Hirst, A.M.I.Gas E.*

Paper delivered in Bristol on 8th December, 1960.

The paper deals with the industrial gas load in the South Western Area, which covers 8,250 sq. miles, with an average population density of 376/sq. mile, which has shown a steady increase during the last 10 years. Approximately 90 per cent of the industrial activity is concentrated within a radius of 50 miles from Bristol, and industrial gas sales, which now represent 17·5 per cent of the total, are 52 per cent higher than in 1951.

The Area is covered by an industrial gas sales organization with a staff dispersed in eight centres. The Area Industrial Engineer is based in Bristol, and a Technical Test Engineer is available to carry out fuel surveys and tests in any part of the Area. An Area industrial showroom displays representative items of equipment and provides facilities for development of special equipment on a limited scale.

Approximately 10 per cent of the industrial gas load is taken by the various aircraft firms in the Area, and it is in this field that development of new techniques has been most noticeable.

In 1956, Normalair, Limited, of Yeovil, was increasing the test facilities in its high-altitude laboratories and made a request for an air heater capable of delivering clean air at a pressure of 250 lb. sq/in. at a temperature of 1,100°F and at a mass flow of 58 lb/min. At that time, there was no record of similar plant operating in this country, and a heat exchanger was designed in the Area Industrial Office. The prototype was constructed by Industrial Furnaces, Limited, and commissioned in 1957; it has since been operating as an integral part of the research equipment.

A further request for a similar air heater, but capable of a greater mass flow, was received from Rotol Airscrews, Limited, of Gloucester, and this was installed during 1957.

Development of ramjet engines by Bristol-Siddeley Engines, Limited, led to the need for simulating flight conditions at speeds up to Mach=4·0. To meet these requirements, the specification for the air heater included clean air delivery at a mass flow of 600 lb/min, at a temperature of 650°C and 200 lb/sq. in., with flexibility down to 60 lb air mass flow/min at 120°C. This specification called for a different design of heat exchanger. In co-operation with the Area Industrial Engineer and the Gas Council Research Station, the plant was designed and built by Industrial Furnaces, Limited. The main features of the new design are two identical units, each 4 ft 6 in. diameter and 14 ft high, heated by three high-velocity air blast burners firing downward through a central combustion chamber lined with stainless steel tubes.

When British Railways closed its gas-manufacturing plant in Swindon in 1958, the South Western Gas Board undertook to supply gas and carry out a survey of existing equipment. New designs for various furnaces were submitted and prototypes have been installed.

The intention of the paper is to emphasize the need for constant development to meet new demands and new manufacturing techniques.

Discussion

Mr. T. H. Pardoe (Bristol) said it was most difficult to produce a paper of this type without making it a series of case histories. If these histories were of something original, he was all for them, and the authors had given some examples of original design. The type of paper went under the heading "Development," and to achieve the right development one wanted development space. They had a small showroom and a small room in which to make a prototype, but if they moved to Avon Street they should need more room for development. Their budget for development work was £1,000/year, for which amount one could not get much, although they seemed to have managed pretty well. It did, however, involve doing the design themselves, with the development in the customer's works, which they had done successfully.

He would like to have seen more reference to positive selling of industrial gas and the need to do so. The Board's industrial engineers must be full of drive—always on the look out to improve existing processes using gas as a fuel—and never, never fully satisfied with any job they had done. If ever they reached a state of complacency, they should certainly lose sales.

With competition as it was, the necessity to produce new designs and methods for heating processes was absolutely paramount, and the authors, although they had made the point, could have stressed it a bit more.

The paper, he said, described a new design of billet furnace for Singers. Some years ago, Mr. Spital made it very definite that he did not think much of gas furnaces and was going to get some electrical ones. A new design had been patented, and, whereas the existing furnace had an efficiency of about 6 to 10 per cent, the new one would operate at 40 per cent efficiency. The present furnace would have an output of 200 billets an hour, the new one 600 to 800. The production would be more than doubled, while operator comfort was at a maximum; still, he was not satisfied. Reference had been made to recirculation. What went in had to come out, but it went around probably up to 100 times in an hour, so that there was better heat transfer and higher efficiency and much more even temperatures.

The pebble heater to which Mr. Hirst referred was a most interesting development. Bricks for the pebble heater, 4½ in. by 4½ in. by 3 in., could cost up to £34 each. Industrial furnaces had used fused alumina, which ran at about £5 per brick. Thermal shock had to be taken into account, with waste-gas temperature going out, and the brickwork at the exhaust 600°C, directing in cold air and blowing it on to refractory at this temperature. Considering air at 2,000°C, one could not see them holding this load, and other means of heating would have to be used.

Reference was made, also, to the use of electronic equipment, but unless the circuits were carefully arranged and the equipment were of the highest quality, there would be many breakdowns.

Mr. A. P. Jennings (Torquay) said that, concerning the figures given on the sheet inset between pages 9 and 10, he was not quite clear about this particular furnace; apparently, the air went around a number of times in working up, and then passed forward. How could one pass forward within the container and yet pass more air into it for recirculation? Did it go forward into an accumulator before it was passed around? The cooling rate was something else. What was important was: Did they use hot air on the "run down" and was it really an increase in insulation?

Mr. A. G. D. Yeaman (Bristol) said he had the impression that one of the great benefits of the new tunnel burner, which had been designed by the Gas Council's Midlands Research Station, was that it had a very good " turn-down " ratio. It had, however, apparently been thought wise to install burners in triplicate in the air heaters at Bristol-Siddeley Engines, Limited. Was it, he asked, because the " turn-down " ratio was not as good as he thought, or were there other considerations to be taken into account?

Mr. J. Reeves (Industrial Furnaces, Limited) said that the merits of the " turn-down " ratio on the air heaters at Bristol-Siddeley Engines, Limited, made a very favourable feature because kerosene burners were really wanted and one could only get 3 : 1 " turn-down " with these. It was only due to the fact that a higher " turn-down " ratio was obtainable with gas that the heaters were gas-fired ; gas was much easier to light, and was a much more usable fuel. They went to the Gas Council for tunnel burners as they wanted a " turn-down " ratio of 27 : 1, but were told this was impossible ; consequently, three burners with 9 : 1 " turn-down " ratio had to be used. With the air-heaters, one not only had to compensate for loss of temperature, but also for a loss of flow ; both of these amounted to quite a big " turn-down ".

Mr. D. W. G. Scott (Bath) thought the performance excellent, especially in competition with electricity and oil, but, in connexion with British Railways, Swindon, there was a comment that results obtained fully justified the claims that work could be carried out by gas as economically as by oil and with improved results. Would this, he asked, apply also to oil in the form of liquefied petroleum gases, which were becoming more popular amongst industrialists, and how real was the danger of industrialists taking these L.P. gases for use with appliances fitted by the gas industry?

Mr. T. W. Clapham (Bath) said it was also interesting to note that 52 per cent increase in the industrial gas load was taking place within about a 50-mile radius of Bristol. He would like to draw attention to the statement in the paper that since 1950 there had been a decrease of 7·4 per cent in total gas sales. This was not quite correct. They had lost only about 5·5 per cent and, taking last year into account, the loss was very small. They were on the right road, perhaps due to the industrial gas load that had been gained quite recently.

One thing that affected the Board's production department was the necessity to produce gas at the right time and distribute as required. Domestic loads brought seasonal variations, and what they would like would be a 24-hr industrial load, which would make them very happy.

Authors' Replies

Mr. K. G. Eccleshare, in reply to Mr. Yeaman, said there were reasons why it was not always advantageous to put in one burner even with the greater " turn-down " ratio of these burners. One could not go beyond certain limits ; for one thing, it involved working on stoichiometric instruments and their valves did not work as finely as one would have liked. To have one burner that would burn 15,000 cu. ft/hr of gas and " turn-down " to probably 1,000 cu. ft/hr was asking rather a lot ; in general, if it were practicable to split the burners it proved more satisfactory for maintaining combustion conditions. There were still difficulties in the construction of burners : the larger the burner, the more chance there was of it breaking down.

Mr. C. H. Hirst, replying to Mr. Pardoe, said that not one of the industrial engineers he knew was satisfied with his results, but otherwise he would support Mr. Pardoe in everything he said.

Replying to Mr. Jennings, Mr. Hirst said air entered the plant through a 4 in. header, passed through a number of hairpin tubes, was supplemented from further headers at various stages, and passed out to process. There were means of by-passing the air to atmosphere or elsewhere ; the air was not recirculated, but only the products of combustion.

The cooling rate was, perhaps, not important, but they wanted to know it because when they were operating a small test piece they would want to go down very quickly to lower temperatures. Normalair bought special valves for this purpose, but at Rotol they were expected to cool the air in 5 min, which was quite impossible.

In reply to Mr. Scott, **Mr. C. H. Hirst** said that a small amount of L.P. gas was 3s. 6d./therm, but if, on the other hand, one had a consumer like Vauxhall, which used Mobil gas (butane and propane), the price dropped to 10d. and 11d./therm.

Generally speaking, a question like this involved policy, but, if an industrialist were going to use only a small amount of butane and propane, the supply of this and the relatively high cost might keep gas in the market. Reliability of supplies also came into the question, as was found in the recent Forest of Dean emergency. If, however, they were competing with large quantities, as bought by Vauxhall, they could not say the same thing.

JUNIOR GAS ASSOCIATIONS

London and Southern Junior Gas Association

"The Production of 'Gloco' and the Maintenance of Its Quality", *by B. L. J. Neal and V. Iutz, B.Sc., A.C.G.I., North Thames Gas Board.*

Paper delivered in London on 9th December, 1960.

The paper deals with the steps taken to maintain the desired quality of " Gloco," both in production and in the design of handling and grading plant. The production methods are primarily those practised at Kensal Green Works, while the design section quotes, in addition, examples from other works of the North Thames Gas Board.

Essential properties of a good quality domestic coke are enumerated, and the influence of various factors upon them are discussed.

The Kensal Green coal-classification system is explained, with emphasis on those qualities of the coal that affect the coke, namely, size, swelling index and ash content.

The quality of coke produced depends to a very large extent upon the carbonizing conditions to which the coal has been subjected ; the importance of throughput and temperature are stressed. Uniformity of travel has received special attention at Kensal Green by the use of retort temperature-monitoring equipment on the lines developed by the West Midlands Gas Board. The operation of this is explained, and a typical chart given.

Details of the Kensal Green grading plants are given together with grading analyses. " Gyrex " screens are standard for the grading plants, and particular attention is paid to screen changing. All " Gloco " is debreezed, immediately prior to weighing, over units capable of dealing when necessary with excess of fine material caused by hopper or stock heap segregation.

Since the introduction of " Gloco," daily testing has become very important. The results of the tests for moisture, size range and fire performance are given and compared with the BS:3142 type-L specification. " Gloco " is well within this standard and is, in fact, manufactured to a closer specification.

All consumer complaints are investigated and analysed. This provides a valuable guide to production as well as a measure of consumer satisfaction.

" Gloco " is a premium fuel and the customer is entitled to expect consistency in sizing. This means that greater attention to screening is required together with the prevention of degradation after screening.

There are many types of screen available for grading " Gloco "; these include reciprocating screens, oscillating tray screens, vibrating screens and resonance screens.

The lay-out of handling and grading plants at Kensal Green and Fulham Works are reviewed, and the efforts being applied by the North Thames Gas Board to the satisfactory production of " Gloco " are emphasized. The Fulham installation, being equipped with resonance screens, is a further application of modern screening techniques. Considerable care is also being taken in the choice of suitable equipment and mobile plant for reclaiming from stock, in particular the adequate debreezing of such " Gloco ".

Spiral chutes are desirable in the design of storage bunkers and can result in a reduction of degradation of up to 16 per cent of the tonnage handled. It is thought, however, that further research into other forms of anti-breakage devices is required.

The authors have emphasized throughout the paper the particular carbonizing conditions that require to be maintained and the essential features of good handling and screening plant to ensure a high-quality and consistent premium fuel for open-fire use. To this end, they deal in detail with the testing and other steps taken to ensure these features of " Gloco ".

Discussion

Mr. D. G. Rose (London) explained the difference between " Gloco " and ordinary coke. He said that quality control of coke production had existed for many years and that the trade name " Gloco " had been registered by the former Gas Light and Coke Company 30 years ago. Possibly, he said, pre-war efforts were in advance of their time because there were then four types of carbonizing plant, and at least two types of coal were being used. Deliveries of coke were, therefore, unreliable and inconsistent. In 1958, freedom of price was obtained and the time was ripe for the introduction of a select fuel ; furthermore, the incentive provided by the Clean Air Act was present. Consideration was therefore given to No. 2 coke produced from continuous vertical retorts, which was known to be a good fuel. Since 1958, seven other Area Gas Boards had adopted " Gloco " and had widened the use of the name for this fuel. The prejudice of the public against coke had now been removed, and its sale was growing rapidly. Although the paper was essentially for production engineers, Mr. Rose said that it was of great interest to coke sales staff. He emphasized that continuous attention to the product was important, especially with regard to quality control. Although " Gloco " had been described as a premium fuel, he thought that with the South Eastern Gas Board's " Sebrite " also available it should be called a standard fuel.

Mr. K. C. Mead (London) expressed the view that " Gloco " could be produced from good quality graded or run-of-mine Durham Coals having an ash content of 6 per cent, or less. He thought that " Gloco " could be produced equally successfully in Glover-West retorts, and emphasized that constant adjustments to carbonizing conditions were not necessary. He suggested that the temperature of carbonization and the speed of coal travel should be considered together, and that excessive speed of coke extraction resulted in a loss of volatile therms in the coke. Mr. Mead commented on the fact that spiral chutes in bunkers had often been abandoned, due to their not having special steels or high abrasion-resistant basalt tiles used in their construction. He said that coke plant design must always be a compromise between the ideal and the practical. In closing his contribution, Mr. Mead commended the North Thames Gas Board's extensive adoption of schemes of dust control.

Dr. F. A. Burden (London) re-emphasized the necessity of consistency of quality and the inter-relation of size and reactivity. Strictly speaking, he said, reactivity was a property of the coke substance not affected by variations of particle size or by other physical considerations. In measuring it, the effect of other factors is eliminated or reduced to constancy, as in the C.A.B. test. As the measurement of reactivity is rarely of any value in the assessment of coke, it is always better to use the term " combustibility " or " performance ", unless talking about the true reactivity of the coke substance. Dr. Burden registered a plea for regular sizing of coke, and said that appliances are normally made for a particular fuel size and that over-size could often give trouble, especially on convector fires and openable stoves.

Mr. G. H. Fuidge and **Mr. A. P. Portchmouth** (London) agreed that the name " Gloco " had helped to popularize the fuel, but that its success was due basically to its constant quality and maintenance of standard. Experience of the South Eastern Gas Board with the sister fuel " Sebrite " had confirmed these views. They gave an account of the development of " Sebrite," which is produced from a blend of about 6 per cent of peat with washed Durham coal, and had an ash content of 5 to 6 per cent and a swelling number of 8. The mixture was carbonized in intermittent vertical chambers on a 12-hr cycle. The charges were steamed to a maximum of 3 per cent and the coke produced conformed to B.S.S. type L, but had quite a high bulk density of 28 lb/cu. ft, a moisture content of less than 8 per cent, and about four volatile therms per ton.

Other interesting points that emerged from the discussion were that the production of " Gloco " required a careful, but not elaborate, control of carbonizing conditions ; that the throughput for " Gloco " from selected coals could be up to 10 per cent greater than normal, and that good maintenance of coke-handling, screening and recovery plant was necessary, in order to keep the consistent quality of production.

The **Authors** replied to the questions.

Manchester District Junior Gas Association

"Ten Years' Working for Safety", *By H. G. Hall, A.M.I.Mech.E., Safety Officer, North Western Gas Board.*

Paper delivered in Manchester on 7th December, 1960.

The author recalls that the Gas Act, 1948, places an obligation on the various Gas Boards to concern themselves, *inter alia*, with the health, welfare and safety of their workpeople. The paper briefly reviews the setting up of a safety organization in the North Western Gas Board, designed to cover all parts of the Area.

The safety officers inspect works sites and processes, lecture on various training courses, work with the medical departments in training in artificial respiration and the use of breathing apparatus, investigate accidents and make recommendations for their prevention.

The constant need for economy has prevented the launching out into grandiose schemes that might have achieved safety at great expense. Other means have been applied if possible, but where dangerous conditions exist the necessary money has been available, even though some of the major projects have had to be spread over some years.

Perhaps the most important achievement in the field of safety is not the visible changes in plant or equipment, *etc.*, but in the attitude of mind of management, using the term in its broadest sense to cover all those in control of men or operations.

The history of accidents to Board employees shows that the numbers have been halved in 10 years. During this time, employment has also dropped, but nonetheless there has been a steady decline in the accident rate. The curve has tended to flatten this last year or so, and there is still much to do to achieve the target rate of about half the present figure.

Changes that have taken, or are taking, place in the gas industry have important effects on safety. New methods and processes replace the old. Hazards with which the men are familiar disappear, to be replaced by new ones that may be outside their experience. Before innovations are implemented the responsible person must give thought to the safety aspects. The specialist

safety officer can give invaluable help at the planning stage. He looks at things from a different angle and is more likely to consider the behaviour of people than the ultimate efficiency of the plant or process.

Consideration is given in the paper to many changes that have been observed during the last 10 years. These range from the widespread use of belt-conveyors to the electrification of railways, and cover such matters as modern methods of retort patching, the use of light petroleum fractions, liquid oxygen and, finally, some implications of the Factories Act, 1959.

Discussion

Mr. S. Ashworth (Mersey Group), in a written contribution read by the Honorary Secretary, said he was surprised that reference was made to the use of inert gas for purging purifiers as being costly because of the high capital cost of the equipment, and that, therefore, reliance was placed on the "Code of Practice for the Safe Operation of Oxide Purifiers" laid down by the Safety Rules Committee of The Institution of Gas Engineers. Whilst the code of practice was excellent, there were occasions when it was difficult to abide completely by it, and there was also the possibility that the human element might err in efforts to comply with it.

It was with this in mind that, some time ago, he instructed his technical staff to look again into the purging of purifiers before emptying, and they hit upon quite an effective way, using carbon dioxide vaporized in equipment loaned at a nominal annual charge by the Distillers Company, Limited. This method was subsequently generally applied at all the Wirral works, and there was no doubt of its success.

In the last day or two, five men were injured and taken to hospital after an explosion while they were emptying purifiers at the Dunfermline Gas Works in Fife. It seemed that, while the code of practice laid down by the Institution's Safety Rules Committee had materially reduced the number of occasions when explosions or fires have taken place during the emptying of purifiers, there is still the possibility of the occasional explosion when the purifying plant has not been purged with inert gas.

Mr. Ashworth went on to say he was a little surprised that the Wirral method had not been more generally applied in the Board's Area, since he felt it had many attractions, particularly as little capital expenditure was involved.

Mr. Hall replied that the system appeared to provide one possible answer to the problem, and he was anxious to see it developed in other areas.

Mr. L. Hearfield (Linacre) pointed out that there had been no mention of cat ladders in the paper. **Mr. Hall** said that wherever workpeople were going to work on a roof, cat ladders or walkways must be provided ; the steeper the roof the more there should be.

Mr. J. Rimmer (St. Helens) referred to the suggestion that those in authority were reluctant to instruct tradesmen in the safe way of carrying out a job. He considered safety was primarily the function of supervisory staff. Every accident should be used to show where supervision had failed and to show what should be done, or avoided, in the future.

Mr. Hall replied that in America, where more importance was attached to the safety aspects of supervision, foremen and chargehands were in some cases not considered for promotion unless they had a good safety record. With the backing of management, the same could be done in this country.

Mr. C. W. Hemingway (West Lancashire) pointed out that there was no reference to safety on water gas plants, on which serious accidents had occurred. Most accident-prone were those mechanically operated, which were not hydraulically controlled. On this type of plant, anyone could go to the auto-operator and operate it even if the key were out and the sign "Man Below" displayed. This was something that ought to be taken up with the manufacturers. It ought to be possible to fit an interlocking device on the automatic operator. Mr. Hemingway enquired also about safety committees, which could encourage men to bring forward matters of safety.

Mr. Hall agreed that the accident record of water gas plants had not been good, and said that the trouble was not confined to mechanical operators. Makers had not made them as foolproof as is desirable. Works safety committees were a useful tool in the safety armoury, and could encourage safety practices.

Mr. H. Dobson (West Lancashire) said that to make cheap gas consistently a works must be efficient, and safety was a factor in efficiency. On the question of purging purifiers, it should be borne in mind that purging must be carried out before and after emptying. He believed that much of the trouble in this operation was due to leaky valves. He thought they should aim for something better than an accident rate of 1.

Mr. Hall replied that the accident rate was down to 2·37, and if they reduced it to 1 it would be a big improvement.

Mr. A. H. Barrington (Headquarters Coke Department) said that much of the consultation on safety matters took place on consultative committees. Stressing the importance of supervision, Mr. Barrington said he recalled seeing a man cutting steelwork without wearing goggles, because they misted up. Some employees contributed to so many sick funds that they were better off financially when staying away from work.

Mr. B. Isherwood (Manchester) said Mr. Hall's paper had dealt with accidents to personnel. It would be interesting to hear something about accidents to plant and apparatus. Mr. Hall replied that accidents to plant was a subject in itself.

Mr. C. A. Young (South Lancashire) said that the Safety Officer and the Medical Officer could take a lot of the credit for the progress in safety standards achieved in the last 10 years.

Codes of practice, rules and regulations had helped the gas industry to achieve higher safety standards, but he did not think they would be a lot of good from now on. The worker must be convinced that management is sincere in its desire to stop accidents. If accident prevention were based on economic considerations, rather than on welfare, three things stood out : (i) accidents must be stopped because they cost money, (ii) disciplinary action must be taken against those who disregarded regulations, (iii) accident-prone employees must be given a change of job, or sacked.

Mr. Young said every effort should be made to keep a man at work, whatever the cost. Light work could help recuperation. In this connexion the 12-day rule concerning benefits should be abolished.

Steps should also be taken to speed up the settlement of claims.

Mr. Hall replied that management had a responsibility to see a man went home from work safe. Economics were a good reason to use to persuade management to assume their responsibilities. On the labour market, as it had been in recent years, it was difficult to contemplate disciplinary action against persons disregarding regulations. Mr. Hall added that one of the reasons why legal claims took a long time to settle was because time was needed to see to what extent a man was going to recover or be affected in the long term by the injury.

Mr. L. Mather (Macclesfield) said two pairs of stepladders were bought from a manufacturer's brochure, and when, subsequently, one pair fell over with a man on the top it was found that the steps were not well made. When a complaint was made to the manufacturer, the reply was that the manufacture of ladders is a competitive business.

Mr. Hall said that when buying articles like ladders the safety officer should be consulted.

Mr. K. Summersgill (Technical and Planning Division) said that accidents were not confined to those who neglected to abide by regulations. Often, they involved a first-class workman genuinely trying to do a good job quickly, and disciplinary action would be unfair. Opposition had been expressed to using masks in customers' premises, because it was said that a consumer would never use gas again.

Mr. Hall said disciplinary action must be used only when it is just and necessary. Opposition to breathing apparatus had to be overcome. He could see no reason why breathing apparatus should not be worn in consumers' premises.

Mr. H. Partington (North Cheshire) thought the distribution side of the industry had a fairly clean accident sheet.

Mr. Hall said that three or four years ago accident figures in distribution were good, but recently that position had deteriorated until, three or four months ago, they actually rose above the figure in the production section of the industry. They were still above the accident rate in the Sales and Service Department, whose accident rate had deteriorated recently.

Northern Junior Gas Association

"Training Gas Fitting Apprentices", *by W. H. Deans, Assistant Lecturer in Gas Fitting, Stockton-Billingham Technical College.*

Paper delivered in Sunderland on 20th October, 1960.

The author states that in examining apprenticeship training, one should bear in mind the necessary aspects of craftsmanship that affect any tradesman. He should (i) know how to handle tools of all descriptions, particularly modern mechanized equipment; (ii) be up to date and have knowledge of all kinds of materials in respect of their production and adaptability; (iii) apart from natural aptitude, be able to choose the correct tools, *etc.*, for any particular piece of work; (iv) be neat and tidy and conscientious in both his trade and the work he has to do; (v) be fully conversant with all precautionary methods, and, in the event of accidents, be capable of rendering local first aid; (vi) maintain throughout a confidence borne of personal achievement and moral responsibility.

The teacher should be well qualified in his particular calling. He should have attained a much higher standard than that he teaches. His experience should be based on many years of actual and direct experience in the art itself. Academic qualifications are not sufficient; they merely indicate a level of individual attainment. He should have practised the art in every way (apprenticeship, journeyman, overseer, and instructor), for these are essential for industrial experience. As an individual, he must be conscientious, sincere and understanding. Human relationships of an industrial nature are most complicated and important. He must be a strict disciplinarian, not a dogmatic enforcer of regulations, but a firm, guiding influence, complying with a worth-while, reliable pattern of study and interpretation. His realm of contact with the students should go beyond the border of the specialized instruction and find time for social contacts. This can take the form of extraneous discussion, works' visits, even outings.

In the enlistment of students, says the author, economic conditions create circumstances that cause troubles. Because of the trend of modern society, work that offers more remuneration is preferred before work that opens out a career. Thus, in some areas where full employment persists, the tendency is for the poorer type of students, academically, to be those left for less remunerative opportunities. On the other hand, where opportunities are not so prevalent, a better type of student is available.

Another important feature regarding students who have just left day school is their general education standard. The education officer of a very large combine agreed with the author, that the level of learning seems to have been lowered in comparison with that of 30 years ago. This may seem controversial and debatable, considering the improvements in education and the consequent increased costs. The cause, however, is the shortage of teachers, overcrowded classes and laxity in discipline and training. Many "secondary modern" children appear to be woefully weak in the "three Rs", with the result that before a specialist teacher in a Technical College can proceed with his own line of study, he has to revise these basic elementary subjects.

Ideally, before an apprentice can be trained successfully, the student must be willing and pliable, the teacher must be energetic and capable, the training must be comprehensive and conclusive, the examinations must be fair, acceptable and balanced, the undertaking must be responsible, co-operative and sympathetic, and the College must give full support.

The gas-manufacturing station is the factory, says the author, the distribution department is the window, and the gas fitter is the practical ambassador, but can only be so in so far as he is thoroughly and efficiently trained.

Discussion

Mr. L. Nelson, on behalf of **Mr. L. Scott** (Newcastle-upon-Tyne) read some comments in which Mr. Scott said it was important that a teacher should have full knowledge of his subject. Regarding the intake of new apprentices, Mr. Scott said that some form of examination is given to proposed entrants in order to assess their general knowledge and mechanical aptitudes. He believed that first-class gas fitters should be competent both in maintenance and new fixing work.

In reply, **Mr. Deans** agreed in part with Mr. Scott, but said that the examination in the City and Guilds of London Institute is based on the ability of the apprentice to fix apparatus.

Mr. W. R. Jessop (Saltburn) thought Mr. Deans was rather sceptical of the type of apprentice admitted to the industry.

In reply, **Mr. Deans** said he was of opinion that a number of new apprentices were not up to the standard required.

Mr. Phillips (Carlisle Technical College) spoke of the difficulty in providing courses at Technical Colleges where the number of students is small, and suggested that it could, in the case of, say, Cumberland, be possible to group all gas fitting apprentices into one Technical College.

Mr. C. H. Ling (Darlington) said he believed a gas fitter was the only craftsman who had to qualify by examination to receive top rate of pay. He suggested that a new apprentice should spend the first year of his apprenticeship at the Technical College before commencing work at the undertaking.

Mr. G. E. Haddon (President; Stockton-on-Tees) said that, in the past, maintenance by systematic calls was carried out by a lower-grade fitter, but a first-class fitter should be able to do both fixing and maintenance. He believed that apprentices should go straight out on to the district, and expressed the difficulty experienced when choosing the type of fitter for industrial work.

Mr. C. A. Robson (Newcastle-upon-Tyne) commented on the amount of electrical apparatus employed on gas appliances, and wondered how much training of apprentices was done in this field.

Mr. J. Brownlee (Hexham) said he received great help from the youth employment officer in the selection of apprentices. He said he had found a great weakness in apprentices in reading gas rates on a meter when checking appliances.

"Opportunity in Prosperity", *by E. Sheldon, Heating and Special Services Officer, Tees-side Division, Northern Gas Board.*

Paper delivered in Newcastle-upon-Tyne on 24th November, 1960.

The paper aims to set out the present-day trends in the use of gas from all points of view, and to place these facts in such a way that the young gas engineer will deliberate before deciding to follow the path so often taken in the past, namely, in the production field. The purpose of this is not to denude that side of the gas industry of its potential engineers, chemists, *etc.*, but rather to set out the prospects of the industry as a whole.

In times of prosperity, some industries find business comes to them without a great deal of effort; an air of "of course, it will last for years" attitude persists to lull people into a feeling of complete security. One cannot afford to relax overall sales acumen, otherwise the future open to the coming generation in the industry will not be very rosy.

Our predecessors had a much more open field, largely due to the fact that electricity was in its infancy and solid fuel was so slow and laborious that gas was the only answer to a long-felt want. Such was not the case today. The two main competitors, electricity and oil, have developed along such broad lines that they can be said to have declared war on their respective rivals. The oil industry has its main effect in the industrial field, where it is not always possible to compete so easily, whilst in the domestic field the publicity with reference to a certain "Mrs. 1970" is such that one wonders how anyone could possibly use anything else.

Despite concentrated competition from other fuels, the demand for industrial gas is increasing annually, and, with the emphasis on development, gas is being adapted to suit the needs of more and

more varied processes. But, to achieve an even greater measure of progress, sales and technical service must be first-class in both numbers and quality. Training of engineers for this highly specialized type of work must be expedited without delay if a fair share of all the possible loads is to be secured.

The answer will not be found by allowing our customers to wait or disappear altogether, while most of our technical ability in the form of young gas engineers is busy trying to make some ancillary plant run properly at the works. This work may be important, but how important will it be if such engineers are not needed when they reach the age of 45?

Discussion

Mr. Webster said it was the aim of everyone employed on sales to increase the number of therms sold per consumer. Regarding convector-type fires, he said they were a cheap form of heating, but perhaps not quite so successful as small-bore heating.

Mr. Burns said he took exception to the remarks on young gas engineers being too busy trying to make some ancillary plant run properly at the works, to the detriment of consumers. He thought that manufacture of town gas was important in the life of the community, particularly in the plastics industry.

Mr. Powell (Industrial Department, Newcastle-upon-Tyne) said that, despite the sales of appliances being high, the sale of gas was decreasing, probably because of the higher efficiency of modern apparatus. He suggested that a large amount of industrial equipment now in use was fitted when gas was cheaper, and that every effort should be made to increase the efficiency of industrial equipment in order to maintain the industrial load.

Mr. Brown (Newcastle-upon-Tyne) said that greater use of extractor fans should be made, particularly in small sculleries, to remove water vapour from the cooking operations. He spoke also of the difficulty of installing ducted warm air in existing property.

Mr. Sheldon replied to the many points raised by members.

Western Junior Gas Association

"Gas—On the Right Lines", *by A. Riley, Industrial Gas Engineer, Swindon District, South Western Gas Board.*

Paper delivered at Swindon on 12th November, 1960.

The paper opens with a general statement that since early in 1958, when the South Western Gas Board acquired the industrial gas load of the British Railways (Western Region) Works at Swindon, the total annual consumption had risen to 360 mill. cu. ft in 1960. For 80 years preceding 1958, the locomotive works at Swindon had been entirely independent so far as gas was concerned.

Extending for a total of some 326 acres, the works are divided into three main sections—locomotive, carriage and wagon. The present labour force is approximately 9,000 strong, the majority of whom are employed in workshops and offices with a total roof area of about 78 acres.

In view of the fact that, since the Board undertook to supply gas, the major part of its work has been carried out in the works locomotive section, the author concentrates his interest on that section.

The paper describes the available gas-production plant at the Board's Gorse Hill station when the British Transport Commission in 1957 found itself faced with heavy capital expenditure for the repair and re-conditioning of its own gas-manufacturing plant; also the developments undertaken to meet the new load. It considers also the distribution aspects of the Board's commitment.

The major part of the paper describes the various processes and plant by which the gas supply is utilized. A comparative statement of thermal consumption by gas- and oil-fired furnaces confirms the quantitative economy of gas in this field when identical materials were being processed.

Discussion

Mr. W. B. Claridge spoke of his pleasure in attending the meeting with Mr. Tweedle in the Chair and Mr. Riley presenting his paper, since they had both worked at Swindon with him.

The subject matter had particularly interested him, since he had been associated with the negotiations for taking over the Swindon Railway Works gas load. He thought the railway authorities had been very wise in asking the Board to take on this load, but this had given the Board's staff at Swindon a number of headaches, not the least of which was the problem of meeting the peak load of the Railway Works without the 2·5 mill. cu. ft gasholder.

He thought Mr. Riley had been in a dilemma since, taking a short term view, any increased efficiency in the railway's usage of gas would reduce the ultimate load. A good deal of new equipment had been installed, and to some extent the additional gas consumptions had offset the reduction in load due to increased efficiency.

The railway authorities had been very pleased with the assistance the Board had been able to afford them, and there was the fullest co-operation between the Board's staff and their own.

Mr. Whitehead (Swindon) commented that he now knew a good deal more about the locomotive side as well as the gas side.

He asked if Mr. Riley could enlarge on the comparison between oil- and gas-firing, and said he wondered if he could give some further information on comparative costs.

Regarding the problem of chimney draught, he thought the solution was a very good one, but wondered if consideration had been given to the installation of a fan.

He would have liked to have seen an analysis of the annual gas load of 360 mill. cu. ft; with the imminent demise of the steam locomotive, he asked what portion of the load we would lose and where we could expect increased loads.

On manpower, he suggested that there was a golden opportunity to effect further economies by introducing automatic operation of the holders at the Railway Works.

The Author, in reply, said he thought the costs of gas- and oil-firing were roughly comparable, but there were problems with oil-firing that did not arise with gas, and, contrary to the common belief, oil was not necessarily clean.

On the question of flue heating, he was of opinion that the use of a gas heater was cheaper than installing a fan, and the gas consumed was used very efficiently.

With regard to the gas load, he had assessed carefully the future trend. The load in the foundry was reducing, and, with the cessation of steam-engine production, work there would be confined to repairs to existing plant.

He thought that with the advent of lightweight engines there might be an opening for stress-relieving furnaces.

In the last few weeks, a quotation had been submitted for a gas-fired degreasing furnace.

Mr. J. Bowler (Bath) asked if Mr. Riley could give any indication of the quantity of oil used; had any difficulty been experienced with clogging after changing over from oil to gas, due to carbonization of the oil deposits?

Were gas-fired torches used for cupola lighting, since this would prove to be a useful additional load, and how was ladle drying effected?

The Author confirmed that some cracking of the oil occurred in the Shieldrop burners and caused clogging of the orifices. Gas torches were in use for furnace lighting. Ladle drying was carried out using simple air blast burners.

Mr. F. Craxford (Bath) remarked that it was about 20 years since Mr. Akroyd was President of the Association and also Engineer and Manager of the old G.W.R. gas works, and that the Association had visited the works. They had then had an impression of a plentiful supply of gas, liberally used, and there was evidence then of the opportunities available for an industrial gas engineer.

He understood that a number of motor-car manufacturers used gas for running-in petrol engines. Was there any possibility of using gas for running-in diesel engines?

The Author said there was a good deal of difference between petrol engines and compression-ignition engines, and he doubted if the idea would be practicable, but it would be worth investigation.

Mr. P. Trevelyan (Bridgwater) enquired if Mr. Riley could give an indication of the total usage of fuel in the works, of all types. He wondered how the old railway gas works had utilized its production of coke.

The Author thought that the majority of the coke produced was used within the railway organization, both for steam-raising boilers and normal combustion in stoves and grates.

Mr. Claridge confirmed that this was so and remarked that the coke produced at Swindon was used throughout the Western Region, and the Board had now made arrangements for supplying similar quantities to railway depots within the area of supply.

Mr. W. E. Baggs (Bath) enquired if the Author were able to say what proportion of the total annual fuel bills was represented by the 350 mill. cu. ft of gas consumed.

Mr. Riley was unable to give a specific answer on this point, but did give some indication of the extent to which competitive fuels were used.

Mr. K. C. Eccleshare commented that to some extent the author had stolen his thunder, since he himself was presenting an industrial paper to the South Western Section of The Institution of Gas Engineers at a later date.

On the use of gas burners to assist maintaining correct flue conditions, he said that the use of gas was far cheaper than the capital and running costs of an electric fan, the heat energy being supplied at a very favourable price.

He said also that the thermal energy of the flue gases themselves could be utilized in jet burners in lieu of the use of fans, in re-circulation systems, and thought that this point deserved greater consideration than it received at present.

"A Storage Tank for Primary Flash Distillate", *By C. E. M. Stephens, A.M.I.Gas E., Assistant Works Engineer and Manager (Production), Stapleton Road Works, Bristol, South Western Gas Board.*

Paper delivered in Bath on 3rd December, 1960.

With the aim of producing an economical "peak-load therm," it is the present policy of the South Western Gas Board to use the gaseous products arising from the gasification of light distillate oils in carburetted water gas plants, intermittent vertical retorts and continuous vertical retorts. In order to store sufficient quantities of P.F.D. on the Stapleton Road Works for use on continuous vertical retorts, a storage tank of 200,000 gal capacity was constructed.

The site chosen was near to existing roadways and rail sidings for easy unloading purposes and was adjacent to a 6 in. water main capable of supplying sufficient water for foam-making fire-fighting appliances and near to an inlet gas main to a gasholder for the economical erection of the gas vent line, which allows the volatile vapours of the P.F.D. from the free space of the tank to breathe freely into the gas main.

A 36 ft diameter reinforced concrete slab was laid on 24 pre-cast concrete piles, and upon this the tank, 33 ft 6 in. high 35 ft diameter and constructed of ¼ in. mild steel plate, was sited.

The tank plates were welded by using the "stovepipe" technique in which the weld is laid by starting at the top of the plate joint and working vertically downwards. This method gives greater speed of welding, but less weld deposit is made on the first root run. The main advantage of this technique is the elimination of back chipping. Saving in time on ¼ in. plate is 38 per cent compared with conventional welding.

Due to the flash-point of P.F.D. being considerably less than 73°F, its storage is controlled in accordance with the regulations laid down by the Petroleum Acts of 1928 and 1936. Close liaison during the planning stages was maintained with the local Fire Service to ensure that their interpretation of the Home Office code of practice was complied with.

The bund wall was constructed in reinforced concrete having an earthwork embankment covered with a layer of concrete formed inside the bund area around the whole perimeter. Drainage from the bund area is controlled by a drain valve connected to an interceptor chamber before joining up to the corporation drains.

A 6 in. diameter gas vent line connects the roof of the tank to the inlet main to an adjacent gasholder, and a counter-balanced safety butterfly valve is installed and connected to a fusible link by means of a wire cable. In the event of the tank catching fire, this fusible link will fail at 155°F, slip the wire and allow the safety valve to shut, thereby isolating the gas main from the tank roof.

Two 4 in. pressure/vacuum breather valves are installed on the tank roof, designed to open at 20 in. w.g. pressure and 2½ in. w.g. vacuum. Foam applicators are fitted just below the top curb level, and normal portable foam extinguishers are positioned in the unloading compound. Agreed warning notices are positioned and steam locomotives fitted with spark arresters.

The electrical installation has Group III flameproof equipment, and all flanges are bonded in accordance with The Institution of Gas Engineers Safety Recommendation M9, and the Institute of Petroleum regulations.

Approval as a refinery has been granted by the Commissioners of Customs and Excise in compliance with the provision of the law and the Hydro Carbon Oils Regulations, 1948, the Conditions of Notice No. 179 having been carried out.

A screw-type displacement pump has been installed for unloading the road and rail tankers, and an air eliminator is incorporated in the unloading system.

Disastrous consequences can result from any fire and P.F.D. is a material that must be handled with the utmost care; accordingly, a safety precaution schedule has been laid down incorporating "permit to work" voucher system which ensures that no unauthorized person is allowed inside the compound, that any tools used are non-sparking, and that all persons must deposit matches and any smoking materials before the "permit to work" voucher is issued.

Certificates of ullage are issued to the road tank drivers, and routine checks of safety equipment fitted on the storage tanks are carried out at regular intervals.

Discussion

Mr. F. Tweedle (President; Bath), in congratulating Mr. Stephens on producing an excellent paper, remarked that it covered a very wide field, from welding technique to Customs and Excise regulations, and he was sure that members would have much to contribute to the discussion.

Mr. R. W. N. Cameron (Bristol) asked if Mr. Stephens could give any indication of the loss of P.F.D. that would take place due to evaporation if the tank were not vented to the inlet gasholder main.

Mr. Stephens, in reply, mentioned that he had referred to a paper on this subject, giving details of tests on various tanks, from which it appeared that losses could vary from nil to 1 per cent.

One particular example quoted 0·2 per cent loss during the course of a year, which, taking a throughput of 1 mill gal/annum, represented a cash loss of approximately £75/annum. This loss was prevented by venting the tank to a gas main, but there was, however, still a slight loss of coal gas due to leakage from the Shand and Jurs pressure/vacuum breather valves.

Mr. W. New (Plymouth) asked what method of welding was used on the tank bottom plates; he understood there was some divergence of views on the best techniques to be adopted.

He confirmed that experience at Plymouth had indicated that neoprene diaphragms were unsuitable for use with P.F.D. in the

Shand and Jurs breather valves. He thought that the dipping arrangements on the Bristol tank were very good and represented an improvement on previous practice.

With regard to the drainage of the bund area, he asked if an interceptor pit had been fitted, and mentioned that there appeared to be considerable variations in petroleum officers' requirements in interpreting the regulations.

Mr. Stephens confirmed that one interceptor pit was installed with a 6 in. pipe passing through the bund wall. He agreed that the slot dipping device was extremely useful, and mentioned that manufacturers were constantly improving this type of equipment ; in fact, the type of tank gauge fitted at Stapleton Road was already obsolete.

The bottom tank welding was of the conventional type using the back-step technique.

Mr. G. Edmunds (Powell Duffryn Engineering Company, Limited) confirmed that back-step welding was used, the idea being to minimize any buckling effect on the plates. The short seams across the plates were welded first, followed by the long seams.

Mr. D. H. P. Hammond (Weston-super-Mare) asked for some further information on the welding techniques. In view of the heat losses that would obviously occur, he asked what the time lag was between finishing the root run of the welding and applying the hot pass. He was a little surprised to see that the tank was bedded on a sand and bitumen mixture, since in the event of future leakage from the tank the bitumen would rapidly dissolve and this would have a deleterious effect on the installation.

The Author and **Mr. Edmunds** elaborated on the welding technique used and pointed out that stovepipe welding was considerably faster than normal welding and that, in fact, the hot pass was applied before any appreciable cooling took place. Mr. Stephens pointed out that the object of the sand and bitumen mixture was to enable the tank floor plates to be bedded evenly, thus preventing any unnecessary stresses. This was the accepted practice in the oil industry.

Mr. H. Hobbs (William Press and Son, Limited) took up Mr. New's point regarding different methods of interpreting the petroleum regulations in different areas. He mentioned that his firm had carried out a petroleum installation in conjunction with another contractor, within the L.C.C. area, and the latter authority had insisted that the installation should be below ground. He confirmed that the use of a bitumen and sand screed was quite normal for tank bases of this type.

Mr. Hobbs pointed out that there was a divergence of views on the construction of bunds ; the Institute of Petroleum recommending a capacity of one tank volume plus 10 per cent, whereas the L.C.C. required something approaching 100 per cent capacity. He also asked if consideration had been given to the installation of a water spray, and enquired if the author had any idea of the quantity of water required for spray purposes.

Mr. Stephens, in reply, said that the fire authority had the last word on fire-fighting requirements and in this instance had stipulated that a foam pourer should be installed. He understood that the Bristol authority disliked underground storage installations. He had no experience of the installation of water sprays.

Mr. W. E. Baggs (Bath), speaking as an accountant, said that with so many people and regulations to satisfy it was quite an achievement to have satisfied anyone at all. He was interested to know that the tank was vented into the gas stream, and wondered what loss of P.F.D. occurred from the tank into the holder. Since P.F.D. was so volatile, how did one ensure that deliveries were of the correct quantity?

Mr. Stephens replied that the purpose of venting to the gas stream was to prevent actual loss of P.F.D., and to provide an all-gaseous atmosphere in the tank above the liquid. Regarding measurement of deliveries, normally deliveries were made by tankers of 4,000 gal capacity, with five compartments, and each compartment was dipped before pumping began.

Mr. J. B. Taylor (Bath) congratulated the author on an excellent and instructive paper. He was particularly interested in the safety precautions, which were an essential feature of such an installation. With regard to the venting of the tank to a gas main, he asked if consideration had been given to the admittedly unlikely possibility of vacuum conditions obtaining in the gas main. He stressed the importance of operating a code of practice for safety precautions on P.F.D. installations, and the necessity of operating the " permit to work " system.

Mr. Stephens, in reply, stated that the tank was vented to the inlet holder main and that the possibility of negative pressure conditions was very remote. The " permit to work " system was well established and was the only method of enforcing safety regulations.

Mr. W. E. Beardshaw (Torquay), congratulated Mr. Stephens on producing an excellent and enjoyable paper. He had been very impressed by the lay-out of the installation and the fire-fighting equipment on the tank. He referred also to differences in interpreting regulations, and stated that in a previous installation, at Torquay, the fire authority did not permit the installation of foam equipment on the tank itself.

With regard to the vacuum-box method of testing, he mentioned an interesting experience in connexion with the erection of the Torquay tank. All bottom-plate welds were tested and found to be 100 per cent, and the work was inspected at all stages. On filling the tank with water, however, a sizeable leakage was noticed, which, after emptying the tank, was traced to a particular plate that had inadvertently been " nicked " by a welder during a cutting operation.

He noted that an air eliminator was fitted at Stapleton Road, and suggested that this should be checked at regular intervals, since at Torquay they had recently experienced difficulty due to corrosion of some of the working parts of the air vent valve. With regard to checking the capacity of consignments, he thought that the suppliers normally allowed for any loss in transit, and they had no experience of short delivery.

Institution Register

Deaths

The Council regrets to announce the death of the following members of the Institution :—

(*a*) *Members* :—

Birks, Cyril Douglas (London)	M.1932 ;	died 21st December, 1960.
Pyper, Frederick Gerrard, M.A. (Leicester)	M.1927 ;	died 17th January, 1961.
West, Frank (Friden)	M.1931 ;	died 21st January, 1961.
Williams, Norman Henry, M.Sc. (London)	M.1935 ;	died 14th January, 1961.

(*b*) *Associate* :—

Pearson, Cyril Hammond (London)	A.1950 ;	died 31st December, 1960.

Correction

Apologies are expressed to Mr. J. D. Ashworth (Altrincham), who has pointed out that the John Dawson Ashworth who was reported, in the January issue of the *Journal*, to have died on 18th November, 1960, was, in fact, his father, formerly Engineer and Manager of the Blackburn Undertaking of the North Western Gas Board and who died at Southsea.

Personal Notes

Birthday Honours

C.B.E.—**J. A. Drake**, J.P. (Member)
C.B.E.—**T. M. Jones**, M.A., LL.M. (Associate)
O.B.E.—**M. W. Jones**, M.A., LL.B. (Member)
M.B.E.—**W. A. Evetts**, M.C. (Member)
M.B.E.—**W. H. White** (Associate Member)

Appointments

(*a*) By an Area Gas Board :

EASTERN GAS BOARD
Watford Division
St. Albans Works—
Section Engineer : **F. P. N. Snow**

(*b*) Other :

Mr. T. Albone (AM) has recently been appointed Supervising Engineer (Design) with Trans-Canada Pipe Lines, Limited, Ontario.

Addresses Required

The Council would be grateful to receive the present addresses of the following members, last heard of in the places given in brackets :—

Lt.-Col. E. W. Black, R.E., T.D., (South Africa)
Mr. M. T. Boyden, (Oxford).
Mr. F. Bush, (Southern Rhodesia).
Mr. E. Clark, (Bridlington).
Mr. S. W. Hayes, (Braunton).
Mr. R. Kinsley, (Sheffield).
Mr. K. R. Pollard, (Canada).
Mr. B. R. Sugg, (West Horsley).

Forthcoming Meetings

(*a*) District Sections

THE INSTITUTION OF GAS ENGINEERS—LONDON AND SOUTHERN SECTION

21st February	Paper, " ' Cleanglow ' Production and Marketing ", by C. C. Cunnold and D. G. Rose. (2.45 p.m. Caxton Hall, Caxton Street, London, S.W.1.)

THE INSTITUTION OF GAS ENGINEERS—MANCHESTER AND DISTRICT SECTION

1st February	Special Meeting. " The Development of Natural Gas in France and the Sahara ". (Queens Hotel, Manchester.)

THE INSTITUTION OF GAS ENGINEERS—MIDLAND SECTION

3rd February	Special Meeting. " The Development of Natural Gas in France and the Sahara ". (2.30 p.m. College of Technology, Gosta Green, Birmingham.)

THE INSTITUTION OF GAS ENGINEERS—WALES AND MONMOUTHSHIRE SECTION

2nd February	Special Meeting. " The Development of Natural Gas in France and the Sahara ". (6 p.m. Princes Room, Park Hotel, Cardiff.)

(*b*) Junior Gas Associations

LONDON AND SOUTHERN

3rd February	Paper, " The Preparation and Assessment of Technical Data ", by F. E. Craddock and A. E. F. Lane. (6.30 p.m. Westminster Technical College, Vincent Square, London, S.W.1.)
16th February	Visit to the Royal Mint.

MANCHESTER

2nd February	Visit to the A.C.-Delco Division of General Motors, Limited, Moorgate Road, Kirkby, Near Liverpool. (2 p.m.) Tea. (4.30 p.m.) Short Papers for the F. Johnston Prize :— " Heating the Home ", by J. A. Bywater. " Efficiency Tests on Cochran ' Sinuflow ' Vertical Boilers ", by G. Holmes. " Primary Flash Distillate at Linacre ", by J. D. Wilson. (5 p.m.)

MIDLAND

7th February	Paper, " Experience in America ", by A. Yates, Woodall-Duckham Educational Award Winner. (6.30 p.m. Staff Mess Room, West Midlands Gas Board, Council House, Birmingham.)
21st February	Paper, " Industrial Gas Utilization ". (Staff Mess Room, West Midlands Gas Board, Council House, Birmingham.)

SCOTTISH (EASTERN)

4th February	Paper, " The Accountant's Place in the Scottish Gas Industry ", by A. McPherson. (Kirkcaldy.)

SCOTTISH (WESTERN)

10th February	Paper, " The Engineer's Contribution", by J. A. Ferguson. (6.30 p.m. Industrial Section, Scottish Gas Board, 9, George Square, Glasgow.)

WALES AND MONMOUTHSHIRE (SOUTH)

9th February — Visit to Distillers, Limited, Barry. Paper, "Grid Supplies in North Wales", by Mr. Barker.

WALES AND MONMOUTHSHIRE (NORTH)

8th February — Paper, "Management and Administration for Sales Results", by A. Facer. (Rhyl.)

WESTERN

18th February — Paper, "Some Aspects of Automatic Control on Holder Stations", by D. Way. (Exeter.)

(*c*) Kindred Bodies

The following meetings of kindred bodies have been arranged for February, 1961. Members of The Institution of Gas Engineers who wish to attend any of the meetings, but are not members of the bodies concerned, should apply to the appropriate Secretary at the address indicated.

THE ILLUMINATING ENGINEERING SOCIETY
(32, Victoria Street, London, S.W.1.)

1st February — Paper, "Lighting in Industry in the Soviet Union", by E. H. Norgrove. (6.15 p.m. Y.M.C.A. Social Room, 14, South St. Andrew Street, Edinburgh.)

23rd February — Paper, "Basis of Recommended Illumination Levels in Britain and the U.S.A.", by A. W. Marsden. (6.15 p.m. The Demonstration Theatre, East Midlands Electricity Board, Charles Street, Leicester.)

28th February — Sixth Trotter-Paterson Memorial Lecture. "Long-range Weather Forecasting", by Sir Graham Sutton, C.B.E., D.Sc., F.R.S. (The Royal Institution, Albermarle Street, London, W.1.)

THE INSTITUTE OF FUEL
(18, Devonshire Street, Portland Place, London, W.1.

2nd February — Paper, "Fuel-oil Burner Design", by H. A. Cheetham. (7 p.m. Liverpool Engineering Society's Rooms, 9, The Temple, 24, Dale Street, Liverpool, 3.)

3rd February — Paper, "Plastics in Fuel Handling", by C. A. Brighton. (6 p.m. South Wales Institute of Engineers, Park Place, Cardiff.)

8th February — Joint Meeting with The Society of Chemical Industry. "Coal and its Products in the North East", by W. Jeffrey and D. A. Hall. (5.30 p.m. Chemistry Lecture Theatre, Kings College, Newcastle-upon-Tyne.)

9th February — Paper, "Steam and H.P.H.W. Space Heating", by J. R. Kell. (6.30 p.m. Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, 2.)

15th February — Paper, "The Work of B.I.S.R.A., with Particular Reference to Fuel", by W. C. F. Hessenberg. (5.30 p.m. The Institution of Civil Engineers, Great George Street, London, S.W.1.)

15th February — Paper, "Current Developments in Nuclear Power Plant", by W. R. Wootton. (2.30 p.m. Royal Victoria Hotel, Sheffield.)

21st February — Paper, "Lurgi Gasification Plants in Scotland and Abroad", by T. S. Ricketts. (7 p.m. Royal College of Science and Technology, Glasgow.)

22nd February — Joint Meeting with The Institute of Petroleum. Paper, "Liquid Petroleum Gas: Present and Future U.K. Position", by A. G. Turner. (7.30 p.m. Lecture Theatre, Grosvenor Museum, Chester.)

22nd February — Paper, "Heat Balance of a Modern Peat Briquette Factory", by J. Martin. (8 p.m. Engineers' Hall, 35, Dawson Street, Dublin.)

28th February — Paper, "Instrumentation in Industry", by E. Metcalf. (6.30 p.m. Gas Showrooms Lecture Theatre, Nottingham.)

THE INSTITUTE OF METALS
(17, Belgrave Square, London, S.W.1.)

9th February — Paper, "The Origin and Solution of Some Industrial Corrosion Problems", by E. C. Campbell. (7 p.m. Department of Metallurgy, The University, Liverpool.)

16th February — Paper, "The Growth and Prospects of the Aluminium Industry", by G. W. Lacey, C.B.E. (6.30 p.m. The College of Technology, Gosta Green, Birmingham.)

16th February — Paper, "Plastics *versus* Metals", by P. T. Moore, and H. Hughes. (7.30 p.m. The Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.)

22nd February — Paper, "Metallurgical Applications of Radio-isotopes", by M. C. Inman. (6.30 p.m. The Manchester Literary and Philosophical Society, George Street, Manchester.)

THE INSTITUTION OF CHEMICAL ENGINEERS
(16, Belgrave Square, London, S.W.1.)

21st February	Paper, "Floating Cap Trays for Absorption and Distillation", by W. S. Norman. (6.30 p.m. North Western Branch, Chemical Engineering Lecture Theatre, The Manchester College of Science and Technology, Jackson Street, Manchester, 1.)

THE ROYAL SOCIETY OF ARTS
(John Adam Street, Adelphi, London, W.C.2.)

6th February	Cantor Lecture. "The Chemical and Plastics Industries", by J. Taylor, M.B.E. (6 p.m.)

THE ROYAL INSTITUTE OF CHEMISTRY
(30, Russell Square, London, W.C.1.)

3rd February	Joint Meeting with Brighton Technical College Chemical Society. Paper, "Research and Development in D.S.I.R. Stations", by Sir H. W. Melville. (7.30 p.m. Brighton Technical College, Richmond Terrace, Brighton, 7.)
6th February	Joint Meeting with the London Section, Society of Chemical Industry. Paper, "Fuel Cells", by H. H. Chambers. (6.30 p.m. Society of Chemical Industry, 14, Belgrave Square, London, S.W.1.)

THE PIPELINE INDUSTRIES GUILD
(7, Iddesleigh House, Caxton Street, London, S.W.1.)

14th February	Paper, "Energy on the Move", by Dr. J. Burns, G.M. (6.30 p.m. The Caxton Hall, Caxton Street, London, S.W.1.)

THE COMBUSTION ENGINEERING ASSOCIATION
(70, Jermyn Street, London, S.W.1.)

8th February	Papers, "Scheduled Maintenance of Boiler Plant and Auxiliaries", and "Performance and Cost Control". (Dundee.)
16th February	Paper, "Factors Affecting the Choice of New Boiler Plant". (Bristol.)
21st February	Paper, "Problems of the Packaged Boiler". (London.)
22nd February	Paper, "Preparation and Handling of Coal and Ash in Small Boiler Plant". (Birmingham.)
28th February	Paper, "Fuels for Modern Combustion Engines". (Manchester.)

THE INSTITUTION OF STRUCTURAL ENGINEERS
(11, Upper Belgrave Street, London, S.W.1.)

23rd February	Paper, "Model Methods, with Particular Reference to Three Recent Applications in the Field of Steel, Composite and Concrete Construction", by Prof. S. R. Sparkes and J. C. Chapman. (6 p.m. Institution Meeting Hall, 11, Upper Belgrave Street, London, S.W.1.)
24th February	Paper, "Computers and Structural Design: The Present Position and Future Trends", by R. E. Rowe. (6.30 p.m. The Byng Kendrick Suite, College of Advanced Technology, Aston Street, Gosta Green, Birmingham, 6.)

THE SOCIETY OF INSTRUMENT TECHNOLOGY
(20, Queen Anne Street, London, W.1.)

10th February	Paper, "Process Control", by R. M. J. Withers. (6.30 p.m. The Byng Kendrick Suite, College of Advanced Technology, Aston Street, Gosta Green, Birmingham.) 6,

Library Accessions

The following are a few additions to the Library since the issue of the *Journal*, Vol. 1, No. 1, January, 1961 :—

American Gas Association :

Approval Requirements for Central Heating Gas Appliances. Vol. 2.—Gravity and Forced-air Central Furnaces. (A21.13.2b-1960.)

Approval Requirements for Gas Water Heaters. Vol. 1. (Z21.10.1a-1960.)

Commercial Kitchen Ventilation, by E. A. Jahn.

Design and Performance Characteristics of High-recovery Gas Storage Water Heaters, by J. W. Gergel and J. C. Griffiths. *Research Report* No. 1311.

Economic Significance of Liquefied Natural Gas. The Distribution Company's Viewpoint, by M. Anuskiewicz.

Energy Resource Patterns, by S. H. Schurr.

Gas and Electric Heating in Two Schools.

High-speed Oven Design and Baking Studies. Part 1.—The Polythermic Oven, by T. E. Hampel. *Research Bulletin* No. 81.

Listing Requirements for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems. (Z21.22a-1960.)

Modern Fundamentals of the Heat Treatment of Steel, by S. T. Olinger. Industrial and Commercial Gas Section. *Information Letter* No. 113.

Reverberatory Iron Melting, by S. J. Michaels. Industrial and Commercial Gas Section. *Information Letter* No. 116.

Review of Economics of Liquefied Natural Gas for Peak Shaving, by A. Russell Young.

Tank and Solution Heaters for the Chemical Industry, by N. E. Keith. Industrial and Commercial Gas Section. *Information Letter* No. 115.

Underground Storage of Gas in the United States, 31st December, 1959. Committee on Underground Storage, 9th Annual Report on Statistics.

Vitreous Enamelling of Aluminium. Industrial and Commercial Gas Section. *Information Letter* No. 114.

British Standard 853 : Part 1 : 1960 (Specification for Calorifiers for Central Heating and Hot Water Supply. Part 1—Mild Steel and Cast Iron).

British Standard 3016 : Part 3 : 1960 (Specification for Pressure Regulators for Use with Butane/Propane Gases. Part 3—Variable High-pressure Regulators).

Chemical Analysis in the Routine Testing Laboratory, by H. Bennett. The British Ceramic Research Association. *Special Publication* No. 25.

Japan Gas Association Gas Statistics, 1959.

Removing Hydrogen Sulfide by Hot Potassium Carbonate Absorption, by J. H. Field, G. E. Johnson, H. E. Benson and J. S. Tosh. *U.S. Bureau of Mines Report of Investigations* 5660.

Specification for Line Pipe, 18th Edition. American Petroleum Institute, 1960. (API Std. 5L.)

General Notices

Recommendations Concerning Gas Distribution

Copies of the following publications of The Instituion of Gas Engineers are still obtainable from the Secretary at the prices indicated :—

"Recommendations for Mainlaying". (I.G.E. Publication No. 491; 2*s*. each, post free.)

"Recommendations for the Laying of Steel Gas Service Pipes". (I.G.E. Publication No. 563; 3*s*. 6*d*., each, post free.)

"Recommendations for the Transportation and Handling of Cast Iron Pipes". (I.G.E. Publication No. 575; 3*s*. 6*d*., each, post free.)

Conference on Waste-heat Recovery

The Second Conference on Waste-heat Recovery, organized by The Institute of Fuel, will be held in Bournemouth on 15th to 19th May, 1961. A number of papers will be presented and discussed, and there will also be an exhibition of equipment used in the recovery of waste heat.

Unfortunately, the above dates coincide with those of the 98th Annual General Meeting of The Institution of Gas Engineers and many members of the Institution will, therefore, be unable to attend the Conference. In the circumstances, the Council of The Institute of Fuel will make available to members of the Institution a set of advance papers and discussions at a special price of £5 10*s*. The Institute will also welcome written contributions to the discussions.

Further details may be obtained from The Secretary, The Institute of Fuel, 18, Devonshire Street, London, W.1.

Congress on Metallic Corrosion

The First International Congress on Metallic Corrosion will be held at the Imperial College of Science and Technology, London, S.W.7, from 10th to 15th April, 1961, under the presidency of Sir Harry Melville, K.C.B., D.Sc., F.R.S. The provisional programme includes about 80 papers for presentation under such headings as atmospheric corrosion, underground corrosion, inhibitors, protection by metal and non-metallic coatings and by chemical treatment, cathodic protection, stress corrosion, corrosion fatigue, corrosion in boilers and heat exchangers, *etc.*

Copies of the provisional programme, enrolment form and further information may be obtained from the Honorary Secretary, First International Congress on Metallic Corrosion, 14, Belgrave Square, London, S.W.1.

British Conference on Automation and Computation

This body, of which The Institution of Gas Engineers is a co-operating member, was originally formed as a federation of three separate groups concerned respectively with the engineering application of automation, automatic control and computation, and sociological and economic aspects. These groups have recently been merged into a single organization, the objects of which are :—

(*a*) To stimulate interest in, to spread knowledge of, and to foster the development and applications of automatic control and computations.

(*b*) To afford a common meeting ground for the adhering organizations whereby such of their activities as fall within the purview of the Conference can, if they so desire, be co-ordinated and extended.

(*c*) To encourage and, if desired, to co-ordinate, the presentation at International Conferences of British papers whose subjects fall within the purview of the Conference.

(*d*) To maintain, as may be desirable, liaison with other countries which support such International Conferences.

Three panels have been set up to deal with Education and Training, Research and Development, and Public Relations respectively.

Refrigeration and Air Conditioning Exhibition

The Second International Refrigeration and Air Conditioning Exhibition will be held at Earls Court, London, from 11th to 14th April, 1961. It will include machinery and equipment for every kind of refrigeration, air conditioning and mechanical cooling.

A ticket of admission may be obtained from the Secretary of The Institution of Gas Engineers.

Symposium on the Use and Misuse of the Soil

A Symposium of papers on "The Soil: Problems Raised by Its Use and Misuse", organized by the London Sections of The Royal Institute of Chemistry, The Institute of Biology, and The Institute of Physics and The Physical Society, will be held in the William Beveridge Hall, Senate House, London, W.C.1, on 15th March at 2.30 p.m. One of the papers will deal with chemical aspects of soil fertility and crop production.

Further information and registration form may be obtained from the Assistant Secretary, The Royal Institute of Chemistry, 30, Russell Square, London, W.C.1.

International Household Goods and Hardware Fair

This Fair will be held in Cologne from 24th to 27th February, 1961. Exhibits will include heating and cooking appliances, boilers, washing-machines, refrigerators and household and kitchen equipment generally.

Further information may be obtained from Mr. M. Neven DuMont, 123, Pall Mall, London, S.W.1.

Library

The Library and Reading Room of the Institution are open on weekdays between 9 a.m. and 5.30 p.m. Members may borrow books by post, excepting books of reference and certain others, on application to the Secretary.

Benevolent Fund

Contributions to the Benevolent Fund of the Institution may be paid at any time to the Honorary Secretary of the Benevolent Fund, 17, Grosvenor Crescent, London, S.W.1. It is a convenience if annual contributions are made by banker's order, and it is particularly advantageous to the Fund if such contributions are made by Deed of Covenant, whereby the Fund is able to reclaim from the Inland Revenue an appropriate sum in respect of income tax paid by the contributor. Further particulars, with deed forms and banker's orders for completion, are obtainable from the Honorary Secretary of the Fund.

Officers of District Sections and Affiliated Associations

Sections

Eastern

Chairman :	E. H. Winch, M.I.Gas E., Eastern Gas Board, 52, Sidney Street, Cambridge.
Honorary Secretary and Treasurer :	J. Hunter-Rioch, M.B.E., M.I.Mech.E., M.I.Gas E., Eastern Gas Board, 52, Sidney Street, Cambridge.

London and Southern

Chairman :	J. A. Hepworth, B.Sc., M.I.Gas E., North Thames Gas Board, Monck Street, London, S.W.1.
Honorary Secretary and Treasurer :	J. T. Veryard, B.Sc., M.I.Gas E., South Eastern Gas Board, Katharine Street, Croydon.

Manchester and District

Chairman :	W. Hodkinson, O.B.E., M.I.Gas E., North Western Gas Board, Bridgewater House, 60, Whitworth Street, Manchester.
Honorary Secretary :	J. Castle, B.Sc., M.I.Gas E., North Western Gas Board, Radiant House, Bold Street, Liverpool, 1.
Honorary Treasurer :	A. Harrison, M.I.Gas E., 297, Bramhall Lane South, Bramhall, Cheshire.

Midland

Chairman :	S. K. Hawthorn, M.I.Gas E., West Midlands Gas Board, Saltley Gas Works, Birmingham.
Honorary Secretary :	D. K. Green, M.I.Gas E., Gas Works, Foleshill Road, Coventry.
Honorary Treasurer :	J. H. Wainwright, M.I.Gas E., Gas Offices, Powke Lane, Blackheath, Birmingham.

North of England

Chairman :	B. Richardson, M.I.Gas E., Northern Gas Board, Central Laboratory, Redheugh Gas Works, Gateshead.
Honorary Secretary :	J. R. Matthew, M.I.Gas E., Gas Offices, Thomas Street, Consett, Co. Durham.
Honorary Treasurer :	W. Cummings, A.M.I.Gas E., Northern Gas Board, 30, Grainger Street, Newcastle-upon-Tyne.

South Western

Chairman :	T. W. Jackson, M.I.Gas E., South Western Gas Board, 9a, Quiet Street, Bath.
Honorary Secretary :	F. C. Gay, M.B.E., F.C.I.S., Assoc.I.Gas E., Radiant House, G.P.O. Box No. 141, Bristol, 1.
Honorary Treasurer :	T. A. Nicholson, A.M.I.Gas E., South Western Gas Board, 34, Bridge Street, Taunton.

Wales and Monmouthshire

Chairman :	S. L. Wright, B.Sc., M.I.Gas E., Wales Gas Board, Grangetown Gas Works, Cardiff.
Honorary Secretary :	J. Powdrill, M.B.E., A.M.I.Gas E., Wales Gas Board, Bute Terrace, Cardiff.
Honorary Treasurer :	O. P. Cronshaw, M.B.E., M.I.Gas E., Wales Gas Board, 93, Wellington Road, Rhyl, N. Wales.

Affiliated Associations

Irish Gas Association

President :	J. W. Kneeshaw, Clonmel Corporation Gas Department, Clonmel, Co. Tipperary.
Director :	N. J. Robertson, Assoc.I.Gas E., Alliance and Dublin Consumers' Gas Company, Dublin, Eire.
Acting Honorary Secretary and Treasurer :	Miss D. Colthurst, 24a, D'Olier Street, Dublin, Eire.

Scottish Association of Gas Managers

President :	D. Beavis, M.I.Gas E., Scottish Gas Board, 1, Rothesay Terrace, Edinburgh.
Honorary Secretary and Treasurer :	W. Kirk, M.I.Gas E., Kessington, 29, Union Street, Greenock.

British Junior Gas Associations' Joint Council

Chairman :	T. W. Pickthall, A.M.I.Gas E., North Western Gas Board, Stanley Buildings, Silver Street, Bury.
Honorary Secretary :	L. G. Townsend, M.Sc., M.I.Gas E., North Western Gas Board, Hind Street, Birkenhead, Cheshire.